CHEMICAL & METALLURGICAL ENGINEERING

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CHEMICAL & METALLURGICAL ENGINEERING

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Investment Of Work

CONSERVATIVE financial men recognize that these days are opportune for the investment of money in securities or materials, and particularly so in certain classes of industries which are thought to be liquidated. In other words, the person or firm having had foresight enough to conserve surplus cash may now take it into the markets and receive in exchange the commodities needed for the future in greater ratio of commodity to dollar than can possibly exist in times of business prosperity. This investor believes from past experience that depressions and periods of industrial affluence come in cycles and that it is sound thinking to expect good times in the next swing.

No brief is here supported for those salesmen, writers and other amateur optimists who distill elusive, vaporous expressions to create a general opinion that business is good and the depression is over when such obviously is not the case. The true business optimist accepts conditions as they are today and proceeds to invest with a firm faith in the future revival of economic activity and consequent increase in the value of materials purchased for cash or effort during the restricted period. Certainly no one can think that we are entirely gone to the dogs and that happy days will never come again.

These are elementary facts well known to financiers, but too seldom considered by the salaried individual in connection with the investment of his personal effort. Working for a salary is plainly conducting a business of producing a certain economic good which is marketed with the employer. The market varies with business cycles the same as for other commodities. In financial crises, with the buying power of the medium of exchange—dollar, piaster, tical or what not—increasing coincidently with the decrease in the value of goods while the salary remains fixed, the employee is getting a larger return for his efforts. A great majority of technical men enjoy this position now, notwithstanding individual observations to the contrary. It is, then, the day of the salaried man.

If the technical worker is content to accept this good fortune and continue delivering the same amount of work for the increased pay, well and good. He remains with the majority a fair, average individual. He is acceptable as an employee, but scarcely sought after. For as the value of the dollar increases, so personal effort is at a premium. It is difficult even now to find excellent men available for employment. They are too badly needed and too well appreciated in present affiliations to be released. A price must be paid to secure them. They are in demand because they have invested work.

Increased work, work as a vocation and as an avocation, merits and receives just recompense, and in this world at that. The chap who is a work eater stands forth well toward the spotlight in periods when most men hold a dormant, almost paralyzed attitude toward commercial activity. The market is right for the investment of effort and the wise ones will develop every dyne, not merely to hold the job but rather for the accretion of personal wealth in the final accounting.

Responsibility Holds the Better Man

NOT long ago the president of a concern employing engineers and highly trained salesmen, with main offices in the East, was asked by a friend for the name of his district office manager, and was surprised to learn that there was no manager of the Western territory. Each man in that office reported directly to his particular department head at the home office. The nature of the work was such that there was little in common among the different departments. The men in the district office were of the type that could be relied upon to work with one another on those matters that might call for co-operation among departments. A chief clerk acted in details of stenographic help, supplies, etc., but without authority over the various units. The plan continues to operate successfully.

Examination of the district offices of many highly organized industrial companies reveals the fact that the individual efficiency of the better grade employee is markedly lower than might be supposed. When men worthy of responsibility are made to feel the yoke of servitude, they become reconciled to drawing the pay check and taking it easy. Servants in the Orient can prepare a meal, it is true; but one must draw the water, another carry the wood, another watch the fire, etc. The average efficiency of the total is about 10 per cent.

The other method of organizing intelligent men places the full responsibility for a field upon one man. He is checked by results alone. If he does not come up to the scratch, another replaces him. Very soon the right one is found, and this fellow sticks. He enjoys the weight of the work, the freedom of action unharassed by petty rules, lives his job all the working hours of every day and dreams of it at night.

Admittedly army organization and discipline is fine—for the military establishment where accountability for execution of definite orders accomplishes the result. Technical men are thinkers, and can see that the policy of the concern which hampers freedom of thought and action by such organization is wrong, and if they work for such a company they wilt under the management. They will come to work only for the daily bread.

The president above mentioned has developed a wonderful industrial concern thus based on the highest American business ideals. He employs the best men in his line. He knows that responsibility holds the better man.

Courage a Byproduct Of Research

MANY times these columns have called attention to the manifold advantages to industry of a well-planned and well-executed research program. It requires a serious business depression to show plainly that a business, a corporation or an organized industry which has seriously investigated its technical problems in a scientific manner is also unafraid of the future. That is a point which engineers and executives will do well to mark. Of course it takes a certain amount of commercial foresight, mental courage and common sense to build up an adequate research department and maintain it despite market fluctuations and objections of myopic penny-hounds always present somewhere in the directorate. Such admirable qualities will undoubtedly be a sound foundation for sanity during perilous times, but more than that, the organization will be stout hearted because it *knows*; others can only fear. It knows what its product is, what it will do, where it is best adapted for use, how to make an excellent and uniform product—undoubtedly such a company is getting a lion's share of the orders, and is setting the house in order for a future demand which is just around the corner.

Perhaps these thoughts would find readier acceptance by giving a concrete instance. This can the more readily be done, since it will supply the motive for a brief reminder of the work of the American Malleable Castings Association. In the words of their genial consultant, Prof. TOUCEDA, it happened that when business slackened various members realized that the time was opportune to take up matters that were pending, but which owing to pressure of work they had been unable to take up sooner. It really seems that all got the same idea at the same time, both in connection with research work they desired done and alterations needed at their plants. So despite the fact that the steel industry is operating at 20 per cent capacity, automobile construction is at a low ebb, practically nc railway rolling stock is being built and the farmer is too poor to buy harvesters, the malleable iron men who *know* are going ahead with needed improvements and fundamental research.

What would have happened ten years ago? Competition was then of the cut-throat variety, the lowest bidder often executing work for much less than his total cost, had he only known it. The result, most easily seen and most impressive to the owners, was a dwindling surplus, despite a continuously debased plant; the growing use of only the rawest of immigrants and the shipment of any junk which possibly might be accepted on the contract.

Under these circumstances some of the most capable men in the industry came together from time to time for interchange of ideas, and their first move was the employment of an expert to devise a uniform accounting system. This enabled those plants, at least, to avoid ruinous quotations. But deeper down, it was discovered that the reckless disregard of quality had convinced the ordinary consumer that malleable iron was not only lacking in dependability, but the best of it was of very low strength. Everyone was buying steel castings or forgings—if they came out poor it was ascribed to ignorant manufacture; malleable was condemned as being constitutionally unfit.

With such an outlook, the association resolved to engage competent technical help and give him all available resources to find out what was the matter with American malleable and to show how the defects could be cured. Barring a few notable exceptions, such foundry investigations were unknown; rule of thumb was plenty good enough. Yet to the credit of the association it should be said that it has consistently backed Prof. TOUCEDA in his recommendations, irrespective of cost, and has made no statement of progress unless it had been shown to be backed by incontestable data.

A full statement of the various steps taken during the past eight years which have resulted in a veritable industrial rennaisance would deserve many pages, and has been presented to the technical world elsewhere. It may be summarized by saying that whereas the best of the malleable iron then made had a strength of 40,000 lb. per sq.in. with 5 per cent elongation, the average of all test-bars from the association for the year 1920 broke at 52,000 lb. per sq.in. with 13.3 per cent elongation.

This is one way of appraising the advantage of their research to the quality of their product. In the first paragraph it was attempted to show the effect on the stamina of the industry as a whole. Evidently, some kind of organized research gets results, and pays!

Petrified Wool Fat

THE plea for greater scholarship in chemistry on the one hand and the demand for a more widespread sensing of chemistry on the other have sometimes borne curious fruits. In order to discover the frequent errors in scientific statements made by newspapers we have occasionally intimated that it would be a good thing if the editors of our dailies were to establish communication with someone who could pilot them over the charted seas of science when they want to enlighten their readers. A correspondent from the Massachusetts Institute of Technology sends us a clipping from the Boston *Traveler* of March 10 which indicates that that paper aspires to follow the advice, and yet we fear that, to put it in Irish, their chemist is the kind of a chemist that a chemist isn't. The quotation reads:

"Question: What kind of oil or fat is lanolin?

"Answer: Lanolin is wool fat or wool grease in a petrified condition."

Prof. CIAMICIAN has referred to coal as the fossil energy of the sun, and we might even indicate lanolin as the hydrogenated juices of the sheep—although this would not be an enlightening or happy description. But the statement that it is "petrified" discourages us in our search for scientific scholarship in the revelation of the *Traveler's* chemist.

In answer to the call for broad, general training for chemists we learned lately of a requirement of a great institution bearing a Frinch name that demands proficiency in the history of Ireland as a requirement for the degree of Chemical Engineer. We might get the idea if the aspirants for the degree were prospective pharmacists hoping to learn how to cure snake-bites, for ST. PATRICK was truly a great pioneer in the prophylaxis of this most distressful evil. Then there was ROBERT BOYLE, who made chemistry the profession of a gentleman. and he was a son of the Earl of Cork. But he lived and wrought in England, while science never has seemed to find much of a welcome in Ireland. Perhaps—and we consider this idea to be no less than an inspiration!—the purpose of the course in Irish

history is to prepare young chemical engineers to succeed in politics. We need more scientific vision in politics, and the Irish seem to have a peculiar gift in the direction of getting into office. It is not altogether clear to us how the study of Irish history develops the art, but if it does, then let all the lads who would be chemical engineers be after studying the history of Ireland so as to make them Congressmen and Sinators.

The Lime Industry Looks to Research

RESEARCH was the keynote of the lime industry's nineteenth annual convention, the third since the organization of the present National Lime Association. Almost without exception the speakers pointed out the value of research in all phases of the association's activities—the determination of fundamental data, improvements in limekiln construction and in the technology of lime burning, the development of new markets and the extension of old ones through the application of data obtained from conscientious scientific studies.

Much of the time-consuming organization work has been completed and the association, representing 124 lime producers, is now able to carry out a definite program of research and educational work through the central office staff and the three technical departments —chemistry, construction and agriculture. The following extract from President CHARLES WARNER'S report is an excellent example of the manner in which the problems are being attacked:

> Take, for instance, the problem of developing the best type of quick-hardening lime plaster and mortar. This question is of great importance to the construction field. It has been attempted more or less superficially and spasmodically by many manufacturers as well as in some of the past efforts of your association staff.
>
> Under past efforts the problem has not been suitably solved for the broad welfare of the industry. It has not been until within the fiscal year just closing that we have been able to lay a broad plan for its study, utilizing fellowships at the Bureau of Standards and elsewhere for taking hold of particular phases of the problem with the intention of gradually bringing all these lines together into a broad basic report that will throw the fullest light on the proposition.
>
> To get at this problem there are four major lines of study and research that have to be undertaken, and each of these four major divisions fans out into numerous sub-studies and minor researches:
>
> First—The effect of burning, grinding and hydration in various combinations and in conjunction with other ingredients to locate any refinement in manufacturing processes that may stimulate hardening in the finished product.
>
> Second—The study of any hardening materials which of and by themselves and upon addition to lime will harden the mixed product.
>
> Third—Since carbon dioxide is the ingredient first naturally employed in the normal hardening of plasters and mortars, but, limited by the slow effect and small quantity of this gas found in normal atmosphere, it becomes necessary to determine all materials, such as charcoal, which might absorb carbonic gas in quantity yet hold it so loosely that upon admixture with lime and water a quick release of the carbonic gas would produce rapid carbonization and hardening throughout the mass.
>
> Fourth—It is within the bounds of possibility that we can locate a chemical compound which upon addition in small quantities to lime will immediately establish in the lime an entirely new hardening characteristic and solve our problem in that fashion.

With such a forward-looking spirit of co-operation, we can confidently expect some remarkable developments in the lime industry. The industry and its leaders are to be congratulated.

Steel Production In 1920

WITH the production of steel ingots now running at the rate of about 12,000,000 gross tons a year, and prospects that the rate will drop below 10,000,000 tons in July, the official statistics of production in 1920 appear, showing that in that year 40,881,392 tons of ingots was produced. Even that was not a record production, however, for the honor belongs to 1917, with 43,619,200 tons. The 1917 production did not represent the capacity existing in the year, for while there was a surplus of orders there were physical difficulties in the way of full operation. Capacity has since increased, moreover, so that the 1920 production was decidedly short of the capacity, being hardly as much as 80 per cent. It was a year of difficulties. At the opening, when the iron and steel strike, inaugurated Sept. 22, 1919, was just over, there was some labor shortage and a great deal of labor inefficiency, while there was some shortage of coal and coke, following the outlaw strike in the coal industry. On April 1, when the steel industry had largely recovered from these troubles, the outlaw railroad strikes began, bringing about a shortage in transportation that lasted for months, or until shortage of orders began to affect some of the mills, late in September.

The production of rolled steel in 1920 was 30,970,297 tons, in the form in which steel received its last hot rolling, the total being therefore made up of rods, sheets, skelp, plates, shapes, bars, etc., forging billets and semi-finished steel that was exported. Production of rolled iron was 1,377,566 tons and production of steel castings was 1,251,542 tons.

The year 1920 was fourth best in steel ingot production, but third best in rolled steel, because 1918 was a year of heavy production of shell steel ingots, liberally cropped, and rolled steel did not make its usual percentage showing in relation to ingots. While third best in rolled steel in general, the year made a new record for production of structural shapes, with 3,306,748 tons, and as there was no large tonnage used in freight-car building there was evidently heavier consumption in construction work than would be assumed by those who held that construction work was much restricted in 1920 by high costs. Production of wire nails was only 3 or 4 per cent short of production in the two better years, 1916 and 1917, while wire-rod production was off 11 per cent from the tonnage of 1916, when there was a special demand for rods in connection with defense against submarines and the making of barb wire for land defense. The wire nail production suggests that there was a very fair degree of building activity in progress during 1920.

On the whole, the distribution of steel in the various finished products was not far from normal in 1920. There was no extremely light demand and no extremely heavy demand for any particular product, except in the case of automobile sheets, and the strain there was not in sheet-rolling capacity, but in pickling capacity. It is true the production of rails was only 2,604,116 tons, or 35 per cent less than the record production of 3,977,887 tons, made in 1906, while production of rolled iron and steel as a whole was 65 per cent greater in 1920 than in 1906, but the disappearance of rails as the dominant finished steel product is now an old story. Rails were passed by both wire rods and structural shapes in 1914 and have not come back in any subsequent year.

Presentation of the Gibbs Medal to Mme. Curie

Report of the Meeting of the Chicago Section, American Chemical Society, June 14, 1921, When the Willard Gibbs Medal Was Presented to Mme. Marie Sklodowska Curie

THE Chicago Section of the American Chemical Society met Tuesday, June 14, 1921, to present the Willard Gibbs Medal, founded by William A. Converse, to Mme. Marie Sklodowska Curie.

Her presence in America was the best occasion for the American people in general and for the American scientists in particular to show their appreciation of the great work she has accomplished and is still doing in the chemistry of radioactivity. The presentation of one gram of radium by the President of the United States, a gift of the women of America, the honorary degrees bestowed by leading American universities, the presentation of the Gibbs Medal and the hearty welcome she met everywhere are a few of the means at our disposal to express our esteem and appreciation for the greatest of woman scientists.

Marie Sklodowska, the granddaughter of Polish peasants and daughter of a professor of physics and chemistry, was born in Warsaw in 1867. After finishing the schools in her native city she spent a few years there as a private tutor and then went to Paris, where after three years she obtained the degree of bachelor of science in mathematics and physics. She then continued to work in the laboratories of Professors Becquerel and Curie, and soon after published the results of work accomplished under the guidance and by collaboration of these great French scientists. In 1895 she married Prof. Curie, and until 1906, when Prof. Curie died, they both undertook most successful researches on radioactive elements and radioactivity which aroused the interest of all scientists.

The steps followed in the work leading to the discovery of radioactive elements and in the solution of problems on radioactivity are best outlined by Mme. Curie herself in her address accepting the medal.

Mme. Curie is still a hard worker, and only a few days before sailing for this country she presented a new memoir before the French Academy of Sciences on Gamma Rays and Emissions of Heat by Radium and Mesothorium (*Comptes rendus*, pp. 1022-1025, April 25, 1921).

It might be mentioned here that Miss Irène Curie, one of her two daughters, is also a scientist of note, having already published a series of contributions for the advancement of chemistry, the latest being her study on the atomic weight of chlorine (*Comptes rendus*, pp. 1025-1028, April 25, 1921).

Mme. Curie has been twice honored with the Nobel prize. She is professor at the Faculty of Sciences and director of the Radium Institute in Paris.

At the meeting of the Chicago Section of the American Chemical Society the American chemists, physicists, geologists, astronomers and physicians joined to present their appreciation for the medalist through their respective spokesmen, H. N. McCoy, R. A. Millikan, T. C. Chamberlain, E. B. Frost and W. A. Pusey, while Prof. W. Lee Lewis of Northwestern University acted as toastmaster.

Address by Dr. W. Lee Lewis

In 1910 one of the most modest and retiring members of an unusually modest and retiring organization—namely, the Chicago Section of the American Chemical Society—after a long and faithful service to our section, made it possible for that section to pay its glad homage to those who have wrought immortally in our science. I refer to William A. Converse.

In attaching the name of Willard Gibbs, our greatest American chemist, to this token, it was established forever on an exalted plane of worthiness.

This is the occasion of the eleventh presentation of the Willard Gibbs Medal, the second time it has been presented to a distinguished European.

The list of those who have received this medal attests how well it has served its high purpose: Svante Arrhenius, Theodore W. Richards, Leo H. Baekeland, Ira Remsen, Arthur A. Noyes, Willis R. Whitney, Edward W. Morley, William M. Burton, William A. Noyes, F. G. Cottrell and tonight Mme. Curie, the first woman recipient.

Through all times men have sought to symbolize their gratitude for Greatness, or for what Emerson says might be better called Completeness, in a spiritual manner. The victor in the Greek games was given not an object of great worth but a wreath of wild olives. The prized guerdon of those old days of chivalry and knight errantry was a ribbon or a flower. Coins and medals are struck to commemorate national victories. Similarly the swastika, the cross, the flag of a nation, the wedding ring, the loving cup, the lotus flower, the phœnix, stand for values in human life which are not intrinsic.

In that spirit we are gathered tonight.

We have asked Drs. H. N. McCoy, R. A. Millikan, T. C. Chamberlain, E. B. Frost and W. A. Pusey to address us on some of the far-reaching consequences of the discovery of radium.

Address by Dr. Herbert N. McCoy, "For Chemistry"

The advance of every science is made over stepping stones of great discoveries. Let me illustrate by brief reference to a few of the most notable examples in chemistry.

Priestley's discovery of oxygen in 1774 and Lavoisier's prompt explanation of the rôle of this element in the burning of substances led to the proof that matter is indestructible. This fact is the basis of the most fundamental law of chemistry. Lavoisier's monumental work inspired the famous French chemist Wurtz to write many years ago: "Chemistry is a French science, founded by Lavoisier of immortal memory."

The electrolytic isolation of metallic sodium by Davy in 1810 not only led at once to the separation from their compounds of half of a dozen new metals but foreshadowed the development of the whole science and art of electrometallurgy.

In 1828, Wöhler's preparation of urea from ammo-

PHOTOGRAPHS OF MME. CURIE AND HER DAUGHTER, POSED ESPECIALLY FOR "CHEMICAL & METALLURIGAL ENGINEERING," IN MME. CURIE'S LABORATORY

nium cyanate disproved the hitherto universal view—a view strongly supported by religious dogma, be it remembered—that compounds of carbon obtained from animal and vegetable sources could be produced only through the agency of vital forces. The almost unlimited possibilities indicated by Wöhler's discovery have been amply realized. Today the number of known synthetic organic substances is over 100,000. Perkin's preparation of the first coal-tar dye, mauve, was of course a consequence of Wöhler's work. The thousand or more artificial dyes of today represent only the elaboration of Perkin's discovery.

The periodic system of Mendeléeff and of Meyer gave a system of classification of inestimable value and also furnished the first clear proof that the elements are closely interrelated.

The application of thermodynamics to chemistry in the early '70s by Willard Gibbs gave us the phase rule and served as the most important single contribution to the foundation of the science of physical chemistry. Gibbs' papers are a source of inspiration and information not yet exhausted, nearly five decades after they were written. The medal to be awarded tonight is a memorial to this illustrious chemist.

Van't Hoff's theory of solution, published in 1887, and its corollary, the ionic hypothesis, simultaneously announced by Arrhenius, served for three decades as the foremost stimulating idea for chemical and biological research.

The discovery of radium twenty-three years ago is in every way worthy to be classed among the typical great discoveries just mentioned, and we are assembled tonight to do honor to the discoverer.

Importance of the Discovery of Radium

It is by the developments that arise from a discovery that its true importance is to be judged. If these are epoch-making and if the discovery has been the result of acute scientific insight, prophetic imagination and patient and skillful experimentation, then we are bound to acclaim the greatness of the discovery. Judged by all these facts, the discovery of radium measures up to the high place it has been accorded.

The early history of our science very plainly shows that the rapid growth of chemical knowledge was in no small measure due to the innumerable attempts of alchemists to transmute the baser metals into gold.

While two and one-half decades ago it was rank chemical heresy to admit the possibility of the transmutation of the elements, yet more than one chemist of repute had a feeling that the last word on this topic had by no means been spoken.

The advent of radium threw a clear new light on this most fascinating subject and led to revelations of a wholly unexpected nature. It seems appropriate, therefore, on this occasion briefly to review the current conception of the nature of matter and to point out the advances that have been made toward the solution of

the chemists' and physicists' most difficult problem—the transmutation of elements.

The discovery of radium revealed to science a well nigh unbelievable group of phenomena. We read in our journals that radium emits light and heat, that its rays penetrate light-proof paper and produce photographs like those of X-rays, that in the presence of radium air is ionized—that is, it is made a conductor of electricity. Then came the astounding statement that atoms of radium explode and that material fragments are shot out with velocities fifty thousand times that of a rifle ball; that these fragments are positively electrified atoms of the element helium; that particles of negative electricity (electrons) fly off with velocities that would enable them to travel around the earth between two ticks of a watch; that radium produces a sort of transcendent X-ray that can penetrate the armor plate of a battleship. Add to all this the fact, soon established beyond controversy, that radium produces continuously a radioactive gas, the emanation, unquestionably a new element, and it must be admitted that the like of such news never had been heard before.

Taken at their face value, all the above assertions about radium meant, first, that one element changed into other and different elements, and second, that energy in the form of heat and light were created from no known source. Here was indeed a most amazing difficulty, for the first of these tenets violated one of the basic laws of chemistry—the impossibility of transmutation—while the second was equally careless of the most fundamental principle of physics—the impossibility of creating energy.

We now know that the physicists were right. Energy is not created by radium. It already exists as the internal energy of the atom itself and is only liberated in radioactive change. The chemists, on the other hand, were wrong, since it was soon proved beyond a shadow of doubt that helium and emanation—both elements—are formed from the element radium. Chemists were then forced to admit that radioactive changes accomplish transmutation of the elements.

Structure of the Radium Atom

Of what, then, is an atom composed, and what is its structure? Plainly, an atom is not a tiny, hard, structureless and indivisible bit of material, differing in nature from one element to another. Small as it is, the atom is highly complex. In structure it may be likened to our solar system on a miniature scale. After all, why not? Great and small are but relative terms. What is our earth compared with the sun, nearly a million times bigger and 93 million miles away? And what in turn is our great sun but one faint star of the myriads that fill the universe? Let your imagination have full sway and see an atom of radium as it might appear if magnified to a diameter of a hundred yards.

In the center, a nucleus the size of a cherry. Surrounding this, eighty-eight electrons each the size of a pea. Let the peas be arranged in eleven groups of eight each, so that each pea of the outer eight is 50 yd. from the central cherry and 20 yd. from its neighbor of the same group. Let the inner groups be equally spaced from one another and from the central cherry.

The nucleus has a positive charge equal to the charges of the eighty-eight negative electrons. The whole system is held together by electric forces of attraction and repulsion. The small compact electropositive nucleus, in turn, is apparently made up of eighty-eight single units of the primitive material of the universe—positive electricity. Atoms of other elements are similarly constituted, but simpler, since the atom of radium is one of the very largest. The hydrogen atom consists of a single unit nucleus and one electron, while the helium atom, the next larger, has two electrons.

Atomic systems in general are stable, but in the case of some of the largest and most complex ones, like that of radium, something occasionally goes wrong and the atom disintegrates with a violence a hundred thousand times as great as that of the explosion of an equal mass of TNT. The fragments of the explosion of a radium atom are an atom of helium, an atom of emanation and electrons. This in brief, is the picture furnished by the disintegration hypothesis proposed in 1903 by Rutherford and Soddy.

This modern conception of an atom gives a clear insight into a great variety of chemical matters. Take, for example, the explanation of chemical union. All chemical and most physical properties of an atom depend upon the electrons surrounding its nucleus. Let us assume that the outer ring of an atom can lose or gain one or more electrons. An atom of elementary sodium, let us say, has a strong tendency to lose an electron, and an atom of chlorine, on the other hand, has a tendency to take up an extra electron. If we bring the elements together, they react violently, as we know, and produce sodium chloride—common salt. All the characteristic properties of each element has disappeared. Why? Because the sodium metal owes its metallic properties and its intense reactivity to the tendency of each of its atoms to lose one electron. The terrific effect of chlorine is solely due to its power to extract electrons from any source capable of giving up electrons. In each molecule of salt we have a sodium atom minus one electron and therefore positively charged, associated with a chlorine atom plus one electron, which gives it a negative charge. The two parts of the molecule hold together by reason of the electrical attraction between positive and negative charges. The older explanation of the union was that chlorine has a strong affinity for sodium. But this is all wrong. If Smith lends Jones $10 and you see Smith continually dogging Jones, is it because of the love or affinity of Smith for Jones? Not at all. Smith is attracted only by the $10 he lent Jones!

The valence of an element is the number of electrons its atom can lose or gain in chemical reactions.

Isotopic Elements

The nucleus is the seat of mass and likewise of radioactive changes. In addition to positive electricity, the nuclei of the larger atoms contain a few electrons. In some cases two different nuclei have the same excess positive charge, but one nucleus has a greater number of positive units and a correspondingly greater number of electrons than the other. The result is most astonishing. These different nuclei hold exactly the same numbers of external electrons. Chemically, the atoms are identical. But their nuclei are different and in consequence they differ in atomic weight and in the nature of their radioactive changes, if they are active.

Prior to the discovery of radium it was never suspected that atoms having different mass could be chemically identified. Among radioactive elements many cases of this kind are well known. For example mesothorium, a perfectly definite radioactive element of atomic weight 223.4, is completely identical in chemical properties with radium of atomic weight 226, so much

so that once the two are mixed they cannot be separated. If it had not been for their radioactivity, in which they differ widely, they never would have been recognized as distinct elements. Elements of this sort are called isotopes. Isotopes have the same net nuclear charge and therefore the same number of external electrons. Among radioactive substances many isotopes are known.

But is it not only among radioactive elements that isotopes exist. Thanks to the researches of Aston, of Harkins and of Dempster, we now are learning that several of the most familiar elements, such as chlorine, magnesium and mercury, are isotopic mixtures.

Transmutation of Nitrogen

Although radioactive changes involve transmutations of elements, it must not be forgotten that such processes are spontaneous and completely independent of all physical and chemical conditions. Man is apparently unable to start, stop, hasten or retard any radioactive change. Still in recent years chemists have often seriously considered the question: Can atoms not naturally radioactive be disintegrated or transformed? This indeed is the old problem of alchemy in a more modern setting. About ten or twelve years ago Ramsay thought he had answered the question in the affirmative in the supposed change of copper into lithium under the influence of the rays of radium emanation. But the critical repetition of the experiment by Mme. Curie proved that the lithium found came from other sources.

Recognizing clearly that only the most intense force can possibly penetrate to the nucleus of an atom and so disrupt it, Rutherford made the attack on the problem of the transmutation of nitrogen with the most powerful means known to science—the helium nuclei shot out by the radioactive element thorium C. Their velocity is 14,000 miles a second. When one of these finds an atom of nitrogen directly in its path, it goes straight through the field of outlying electrons, assaults the citadels of the nitrogen nucleus and knocks out fragments. In some cases these are nuclei of hydrogen atoms, in other cases nuclei of a hitherto unknown sort three times as large. What then does this mean in less technical terms? Simply this: This element nitrogen, which is not radioactive, has been transformed into hydrogen and a new element. This is a real transmutation of a common element. Such a transmutation is of purely scientific interest at present. But who dares discount the future?

Atomic disintegration involves two principal things—the production of new kinds of elements and the liberation in part of the internal energy of the atom. The amount of the latter is startlingly great. For example, the atomic energy of a single ounce of one of the heavier elements like lead or uranium is equal to that of ten tons of coal. If it ever becomes possible in future to induce the disintegration of ordinary elements, the value to humanity will come in greater measure from the limitless stores of energy thus placed at man's command than from the possible production of precious metals.

Value of the Discovery of Radium

I have tried to point out some of the epoch-making developments that have taken place in our science as the result of the discovery of radium. These are some of the fruits of Mme. Curie's work. For the world in general the use of radium in medicine has an even greater human interest. If there had been no scientific achievements the gift to medicine of this powerful therapeutic agent would alone entitle this discovery to take an exalted position. When we add to all this the fact that the discovery has given to chemical technology an industry which in America has an annual output worth \$4,000,000, there is but one conclusion: The discovery of radium is the most conspicuous single chemical event of this generation.

All honor to the illustrious discoverer, Mme. Marie Sklodowska Curie.

Prof. R. A. Millikan's Address, "For Physics"

On an occasion which is so rare as this—namely, an occasion on which Mme. Curie is delivering the only address which she makes on this trip to America—I am sure you do not wish me to take any time in giving out words even from the standpoint of physics or from the standpoint of America. I shall therefore do nothing more than to express my delight and that of my fellow physicists in paying our tribute of respect and honor and admiration to one who has contributed to all our sciences, one whom I am proud to say has the title of Experimental Physicist in a university of Paris and one whose discovery has touched not only physics but also chemistry, astronomy, geology and, what is much more important, philosophy. The opening up of the mind of man to the possibilities of this world, due to the discovery of radium, is certainly a philosophical event of immense importance. It seems to me therefore that this occasion tonight is one which represents the word "co-operation" in an unusual way. It represents the co-operation among all the physical sciences, which is to be, I think, the watchword of the decade upon which we are now entering. It also represents co-operation in the mission of bringing forward the progress of civilization by the progress of science, through the magnificent effort by the women of this country in assisting Mme. Curie with the great resources which we happen to have.

Prof. T. C. Chamberlain's Address, "For Geology"

I cannot tell you very well the contribution which the discovery of radium and of radioactivity has made to geology without telling you a little of the struggle through which it has been passing, for it is the contribution of radium and radioactivity to the relief of our difficulties that constitutes its essential contribution to our science.

In the closing years of the last century some of the very fundamental ideas of earth's science seemed to be slipping away, as the severer tests of the dynamics of our planet were brought to bear upon them. It was relatively easy for our forefathers to tell us how matter might be gathered into a globe and how that globe might have some sort of revolution, but it proves to be quite another thing to tell us how matter could be gathered together in a series of globes that should revolve in relation one to another and to their controlling sun in the very peculiar and singular way in which our planets act.

Hypothesis after hypothesis was brought up and tested and failed. It was amended and tested again and failed, and so on, until at length a hypothesis quite distinct from the others in its dynamic qualities was found which seemed to meet the rigorous requirements.

Then it was necessary to test this new hypothesis on other accounts to see if there did not lurk within it somewhere a fatal deficiency such as had been found in the others. One of the first of these tests to present

itself was the question of "adequacy of heat." The old hypothesis had started with the fiery beginning and a surplus of temperature. The new hypothesis was that of an earth built up slowly, very slowly, small particles coming in in such a way as to lose the heat of the impact before it was communicated to the body of the earth, and so the earth grew up like an ash bed—cold, or relatively cold. Whence, then, the heat indicated by volcanic action and other sources? Whence, then the great heat that we supposed to reside in the interior of the earth?

Discovery of Radium Solves Many Geologic Problems

It was in this stage of solicitude when there came information of the wonderful heat-producing powers of radioactive substances, and so at once there came joy and satisfaction from this new discovery. There was no longer any question about the adequacy of heat in the earth or the moon or in any of the bodies that had encompassed radioactive substances in their formation. On the contrary, a difficulty of precisely the opposite source arose. Just as soon as the examination of the surface of the earth had reached an adequate stage it was found that the radioactive material, though very minor in its quantitative amount, was very effective in its heat-producing power. If the center of the earth, if the whole body of the earth, were permeated by radioactive substances as plentifully as the accessible portion, the annual product of heat would be very much greater than the earth is giving forth at the present time. And so there followed the almost necessary inference that the earth must be growing hotter all the time and must have been growing hotter all the time.

Now this conclusion is directly opposed to the geological evidence, and the geological evidence is strong. How, then, is this difficulty, this enforced difficulty, to be met? The only obvious way is to suppose that the radioactive substance is concentrated toward the surface and the quantitative value of its heat-producing power was such that less than one-hundredth of the thickness of the earth's crust would contain a sufficient amount of radium to produce all the heat that the earth is giving forth from the interior annually.

Now, according to the inherited concepts of the interior of the earth, it was once at least in a fluid condition. Some have held that it still is largely fluid. But the radioactive material, being of the heaviest order, ought to have concentrated in the center and not at the surface.

Here was a radical difficulty, but this gave us no trouble, because we had previously abandoned the whole concept of a fluid earth and a fluid interior, and substituted for it a very different concept, a concept which rested upon the stress conditions of the interior. There exists three million times as much static pressure in the center as at the surface, and, besides that, there is a whole group of pulsating stresses in operation due chiefly to outside sources and whose resultants were ten times, or thereabout, as great in the deep interior as at the surface. Thus it is obvious that if there were spots all through the earth possessing a liquefying agency, it would follow as a consequent mechanical condition in so fast and in so far as these little spots became liquid, or the local adjacent region became liquid. Then these would be squeezed to the surface, carrying the little heaters with its own currents of liquefaction. Here, then, was a mechanism peculiarly well adapted to pick up and bring to the surface every radioactive substance in the interior of the earth and lodge it at the surface. Dr. Boulliet, who has written a fine work on geology and radioactivity, borrows this hypothesis and very discreetly says nothing about the difficulty of the old theories.

During the last half of the last century we were sorely belabored by Lord Kelvin and many other great and able physicists and some astronomers, because, as they said, we drew too largely on the bank of time. They had studied long and intently the heat energy of the sun and had found it adequate only to maintain the present output of the sun's heat for twenty or thirty million years, or some such period. They assured us that we were extravagant and must restrain ourselves, and so, bowing to these apparently strong arguments, we were under duress. But radioactivity has completely changed this attitude, and now there is no question about the possible adequacy of the energy in the sun or in the stars or in the earth to maintain the activities which we actually observe.

Radioactivity has brought to us another very precious instrument of great power, an instrument by which we may measure epochs and eras with an accuracy, I think, far greater than before. Geologists have studied the rate of physical and life processes of all sorts and have attempted from these to form some estimate of the age of the various formations and the age of the earth, but these are subject to serious question, because we live in an age just after a great organic revolution by which mountains tipped over and continents emerged. Radioactivity, by the rate of its decomposition, has given a mode which is entirely independent of these conditions. It gives a time measure four, five, six times as great perhaps as the geological methods, but in my judgment these are more nearly accurate than our older methods. So, singularly enough, the discovery of radium and of radioactive processes gives us one of the most needed means for measurement of time.

The discovery of radium and radioactivity has come to us at critical times and has brought us joy and satisfaction, given us instruments of power, and conferred upon us a benefit it is difficult for us to estimate.

E. B. Frost's Address, "For Astronomy"

Mr. Frost stated that there is no group of scientists that has greater interest in the discovery of new elements than astronomers—particularly astro-physicists.

He cited the case of helium, which has so remarkable a relation to radium, and outlined the conditions under which two astro-physicists, a Frenchman and an Englishman, working independently during the solar eclipse of 1868, one in India and the other in England, each detected the presence of a never before identified slender beautiful line in the spectrum of the edge of the sun. A new element was thus discovered, which, they guessed, came very close after hydrogen in the series of chemical elements, and they even surmised some of its properties. But it was only after twenty-seven years that helium was identified in terrestrial sources.

Nebular Orion, shining with its peculiar bluish green light, and spread over enormous space, emits light from which the astro-physicists have identified a gas they call nebulum. The speaker hoped that some day some discoverer with the skill of Mme. Curie would find that gas in some of the products of the earth.

Referring to radium, he stated that it has been something of a disappointment to find that there is no spectroscopic evidence of the presence of radium in the sun.

The work of the speaker on the identification of radium emanations in the solar sphere has not proved successful; some lines have been identified, but the intensities do not match, and some lines which should be there have not been detected. Thus the astro-physicists, when conservative and cautious, are not in a position to identify conclusively the presence of radium in celestial bodies.

Dr. W. A. Pusey's Address, "For Medicine"

I am glad to testify to our indebtedness to the honored guest of this evening for the discovery of radium, because its biological effects are no less interesting than its other amazing qualities. These biological effects were discovered very soon after concentrated radium salts had been produced by Mme. Curie, and tradition has it that it occurred when Prof. Curie himself, carrying radium in his pocket, discovered that it produced a sore. It was not very long after this that the study of these biological effects began and they led to extraordinary results. If the surface of the skin, which is the easiest living tissue to study, is exposed to radium, there is no change for eight to ten days. Where the reaction is slight it is confined to reddening. If the exposure has been longer or more intense, blisters occur on the surface. If it is carried beyond this point, the tissues of the skin are destroyed and in its maximum effect deep ulcers are formed.

The phenomena as studied under the microscope are not less interesting. First, in the mildest degree there is an inflammation; when carried a little further, certain cells are damaged that first show a disturbance of function, then a disturbance of structure, and then, if it is carried beyond this, absolute destruction of certain of the cells. These cells look as though they had been bombarded and broken into fragments. Other cells at this stage of the process will be able, if the process does not go too far, to be restored to normal, but a loss of certain sensitive cells takes place. If the process is carried to its maximum, you get complete destruction of all tissues, everything down to and including bone.

Radium has no effect on dead skin, no more than ordinary light. These phenomena, as they are produced by radium and X-rays, are absolutely unique.

Their application to medicine lies in the fact that radium has a selective effect upon the tissues. Certain diseased tissues are readily damaged. Young cells and those which are highly differentiated and whose functions are special are particularly sensitive to the effects of radium. Through the utilization of this variation in sensibility to the effect of radium we have been able to do very much with radium in the treatment of disease. It has given us new methods of great convenience and effectiveness in handling some diseases we could handle before and it has given us methods in handling some diseases we could not successfully handle before. It has given us a new means of attack on cancer. It has not solved the cancer problem, it has not taken the place of surgery, but it has given us a means of controlling many cases of cancer that we could not control, and of alleviating some cases and of saving patients from the terrors of operations in others.

The work, as you may well imagine, is but in its beginning. Nobody can tell what the effects of radium on therapeutics is going to be, but even at the present time medicine owes a great debt to the discoverer of radium, and we are glad to do homage to Mme. Curie as one of those rare people who have discovered valuable new agents for the attack upon disease.

Dr. Lewis then introduced Prof. Julius Stieglitz of the University of Chicago, Dean of the American Chemical Society, Chicago Section, who was chosen to convey to Mme. Curie the Gibbs Medal.

Presentation of the Medal by Prof. Stieglitz

In choosing the name of our medal of honor the Chicago Section of the American Chemical Society sought to commemorate the work of the man whom we considered the greatest chemist America has ever produced, Willard Gibbs, the pioneer in physical chemistry. The first medal was bestowed upon Svante Arrhenius, a pioneer in the field of ionization, who developed a theory which for twenty or twenty-five years cleared up a great mass of what otherwise would appear as unconnected complicated facts. Great as were the discoveries of Gibbs and of Arrhenius, even greater, Mme. Curie, were the discoveries, the contributions to science which you have made, for you turned the key to the lock behind which the deepest and most fundamental secrets of nature were kept, the secrets of the subatomic world. We who lived in the time when atoms were considered whole and unchangeable can best appreciate the tremendous wonder of what has been accomplished in the last twenty-five years through the discoveries which you developed and through which you led the world of physics and chemistry. The story of the tracing of the pinhead of radium through a ton of pitchblende and other ores is more interesting, more profoundly moving, than any story of conquest on the face of the earth. It is a story of unflagging courage, of persistent self-sacrificing effort, and in gratitude for your work the Chicago Section of the American Chemical Society has asked me to present to you, as a token of its esteem and reverence, this medal, the Willard Gibbs Medal of 1921.

THE WILLARD GIBBS MEDAL

May you take it and esteem it, you and yours, in the same way as do those who are giving it to you, as homage to your courage, to your self-sacrifice and to one of the most lasting and greatest achievements in science which we have to commemorate in our generation. This is your medal, Mme. Curie, from the Chicago Section of the American Chemical Society.

Address of Mme. Curie

I wish to thank the American Chemical Society for having expressed its appreciation of my work by bestowing upon me the Gibbs Medal. I consider it an honor to be present at a meeting of the society which has elected me to membership several years ago. It is also a satisfaction to me to meet here Prof. Millikan, Prof. McCoy, and others whose work in atomic science and in radioactivity I know and highly appreciate.

It was the wish of the society that in this address I

should speak of my early work and give you a short account concerning the discovery of radium. It would be a great pleasure for me to do so, and I think that Prof. McCoy has already given you a view of the various developments of the new science of radioactivity.

The work was begun in the year 1897. At that time Prof. Curie and I were working in the laboratory of the School of Physics and Chemistry in Paris. I was engaged in the study of the uranium rays, which had been discovered two years before by Prof. Henri Becquerel. Becquerel found that uranium salts emit continuously special rays very different from ordinary light, but similar in some properties to X-rays. These rays are able, like X-rays, to make an impression on a photographic plate through an envelope of black paper protecting it from ordinary light, and these rays may also produce conductivity of air, they may produce a discharge, because the air which the rays are penetrating has acquired a force called ionization.

This property of uranium, emitting rays which are similar to those in the X-ray tube, was of course a very strange property and it was natural for me to try to know what it was. The first thing to do was to find a good method for measuring the intensity of those rays. These could be measured by the rate of discharge of an electroscope under suitable conditions, but I preferred a method which seems to me more accurate and rapid, consisting in measuring the same conductivity and ionization by a compensation method using an electrometer. I shall not describe this in detail, because it has been given in several of our publications.

Those measurements were very reliable. Tested in such a way, the property of radiation by uranium proved a very regular one, a steady one. What was more, it was proved that it belonged to all the compounds of uranium in every state and increased with the amount of uranium in the compound. And so I was compelled to come to the conclusion that the emission was an atomic property of the element uranium. This property of matter consisting in the emission of rays has been called radioactivity.

A Hunt for Radioactive Elements

Then the second question I asked myself was whether the element uranium was the only one possessing the property of radioactivity. In order to settle that I undertook an extensive examination of all kinds of elements and their compounds to ascertain if there was any other element which would possess atomic radioactivity. The only one I found was thorium. Radioactivity is high in both uranium and thorium, but this is their only common characteristic. Those two have the greatest atomic weight, but otherwise they have no particular analogies.

In my general examinations of so many chemical products, I had taken not only the pure elements and their compounds, but also some natural products, ores and minerals, and it is then that I came face to face with quite unexpected facts. I expected, of course, that all minerals containing uranium and thorium—and very often the same minerals contain both elements—would be radioactive, but it seemed also from my point of view that none of them ought to have as much radioactivity as pure uranium or thorium oxide. But what I found was quite different! I found several minerals that had stronger radioactivity than the oxides of thorium and uranium, the ratio being as high as four in the case of one sample of pitchblende. In order to explain this abnormal behavior of minerals, I admitted that in those minerals was contained some new element with an atomic radioactivity much stronger than that of uranium and thorium and which could be present in the minerals only in a very small proportion, because they were not detected in the analysis of the minerals. This particular hypothesis has been verified by the discovery of polonium and radium by Prof. Curie and me.

Prof. Curie and I then started a common work for the separation of that new element. We were guided in our work by chemical analysis of the mineral accompanied by measurements of radioactivity. As some products on analysis proved more and more radioactive, we knew that we had succeeded in concentrating the new element, and during the year 1898 we were able to establish the existence of at least two new radioactive elements which were called, the first polonium, being separated with the bismuth, the other one radium, being separated with the barium.

Our purpose was to get these elements in a pure state, because if that could not be done chemical science would not have accepted our statements about the new elements. The difficulty was that the quantity of polonium and radium in the mineral was so exceedingly small. I considered it equal to about 1 per cent in quantity, but now we know that the quantity of radium which really is present in uranium ore is not even one part of a million in a good ore and the quantity of polonium is even much smaller. So that to get a quantity of radium one is obliged to work up huge quantities of ore, a very difficult task for a laboratory.

Lack of Equipment, Help and Money

It must be said also that at the time we did not even have a good laboratory, a good chemical laboratory. We had a place to do some work and we had at our disposal a kind of shed which was not a laboratory at all, only a shed—no chemical arrangements where we could try to do the necessary work for the separation.

The second difficulty was that at the beginning we had no help of any kind and no money. That was also a very difficult condition under which to do that work, and it is just because the conditions were so difficult that the work was not done as quickly as it could have been done under other conditions.

The separation of radium, of course, could have been done within a period of several months, or at least less than a year, but it took us really four years to get the radium completely pure. Even at that time we could not buy pitchblende in sufficient quantity, but we had the idea that radium must be concentrated in the residues of the pitchblende after the extraction of uranium, and we contrived to get a certain quantity at the factory of the Austrian Government, where pitchblende was treated for the extraction of uranium. These residues had no value at that time and were thrown away, but this was the ore that we used. We succeeded in treating quantities up to 50 kg., but it is very difficult to do this kind of work with this quantity in a laboratory. We were obliged to give up doing it that way and to try to get the rough treatment done elsewhere and only the end of the work on the concentrated product was done in the laboratory.

It is not necessary to explain all the details of the work. It is sufficient to say that the proceeding was just the same as that that would be needed to extract barium from pitchblende, because radium belongs to the barium group. The work was centered on the ex-

traction of radium, because this was easier than getting polonium.

The radium extracted with the barium forms a barium-radium salt in which the concentration of radium is indeed exceedingly small. I do not think it could have been determined by ordinary means of chemical examination at that time. It could be deduced only by measurements of radioactivity.

In order to concentrate the radium in that barium-radium salt I devised a method of fractional crystallization. I found that if a solution of barium-radium-chloride is allowed to crystallize, the radium percentage in the barium-radium salt is several times greater for the crystals than for the solution. On that principle a regular working scheme can be established, leading to a very satisfactory separation of radium and barium by a sufficient number of crystallizations, if only the quantity of radium is not too exceedingly small. The crystallization of bromide may also be used with some advantage.

I myself did the numerous crystallizations that were wanted to produce the first pure radium. It was in the year 1902 that I succeeded for the first time in getting nearly 100 mg. of pure, very pure, radium chloride. The purifications by concentration have been all the time accompanied by measurements of radioactivity on the one side, by spectroscopy, and by determinations of the atomic weight of the matter present in the salt. That is also an ordinary chemical matter.

As the concentration in radium was increasing new lines appeared in the spectrum, while the barium lines weakened and disappeared, and the mean atomic weight of the metal, determined by the same method which is used for barium, increased to a limit which I determined to be 226. The atomic weight of barium from which we had started was, as is well known, 137.

So at last the end had been reached, and established without doubt that radium was a new chemical element in the same meaning as every chemical element is. We held the absolute proof that radium is a new chemical element and that the initial hypothesis was justified. These results also have been corroborated by many other scientists.

Separation of Radium Metal

Later I was also able to separate the radium in the metallic state. This was a still more difficult work, because radium is an element which decomposes water very strongly, and I also had a very small quantity of radium. It was always only those 100 mg. which have served.

The separation of radium in the metallic state has been done in the same way as it is done with barium, because the elements are so similar. The groundwork was prepared by the use of an electrolytic solution of radium chloride. After reduction this has been heated in very pure hydrogen, the mercury distilled away and in that way the radium metal has been left as a white metal, like barium. That work is extremely dangerous to the safety of radium, which, as you know, is a very precious material. This experiment has never been repeated by any one else in the world so far as has come to my knowledge.

You may see that the conditions in which this work has been done were from many points of view not easy conditions. Later they have improved. The laboratory which I have now is a new laboratory very much better equipped than ever before. Now I believe that my work will be made even more efficient and more thorough by the interest which your country has so generously given.

The special interest of radium is, as you know, in the intensity of the rays, which is more than a million times greater than the intensity of the uranium rays. It is because of that that the effects of radium rays are so important.

Particular attention has been given, as you have been just told, to the physiological effects of the rays and which were discovered for the first time, as you have heard, in France. It was also in France that the first work of radium therapy was started, which is also sometimes called Curie therapy. This made necessary the production of radium, and so the supply of radium has been provided by factories of which the first has been also started in France.

The first radium came from France, but now America is the biggest producer. Many grams of radium are manufactured every year from the great quantities of Colorado carnotite. The methods used for the extraction of radium are always nearly the same as those which have been devised in our laboratory. All of these methods and all the ways and means and details of the preparation have been already published by Prof. Curie and by myself, for the benefit of science and humanity.

Radium is now a commercial product, but the quantities for sale are not controlled by its weight. It is much more convenient for a substance which is so precious and sold generally in small quantities, to control these quantities by the measurement of the intensity of radiation made under proper conditions, and particularly by comparison with the radiation of a known quantity of radium. So a number of the scientists of different countries decided that it was necessary to have an international standard of radium to make reliable measurement in all countries, and I was intrusted with the preparation of that standard. That was done in the year 1911, when the international standard of radium was prepared in the shape of a small glass tube containing 22 mg. of very pure, anhydrous radium chloride prepared for the determination of the atomic weight. This international standard is deposited at the International Bureau of Weights and Measures near Paris, and it is used only for comparison with secondary standards to be deposited in national institutes in the different countries.

Rays From Radium

During the years when all this chemical investigation was going on, a great deal of work was also devoted to the study of the rays. This work has been done not only by us but by many other scientists, among them Henri Becquerel, Prof. Rutherford, Villard and others. Three kinds of rays have been identified and designated as the alpha, beta and gamma rays. These letters correspond exactly to the three sets of rays which are to be found in an X-ray tube. That is indeed a very curious coincidence.

The alpha rays are positive rays. We know now that they are atoms of helium, carrying a positive charge and traveling with a great velocity, one-twentieth of the velocity of light. The beta rays are not atoms, but electrons—that is, particles nearly 1,800 times smaller than the mass of hydrogen atoms and carrying a unit charge of negative electricity. The speed may come very near to the velocity of light and of course is greater than the speed of the alpha rays. The third, which are gamma rays, are not corpuscular, they are an electro-

magnetic vibration similar to light and to X-rays, but having a much greater frequency.

The penetrating power of the rays varies greatly. The alpha rays have a very small power of penetration and are very easily absorbed even by an ordinary sheet of paper. The beta rays may travel through several millimeters of aluminum, and the gamma rays may even penetrate much more dense material, like lead.

Transformation of Radioactive Elements

I have already told you that besides radium many other radioactive elements have been discovered, and in all cases the same method of chemical radioactive analysis has been used.

The emission of the rays is followed by a transformation of the element. Having expelled either the alpha ray, which is a helium atom, or the beta ray, which is an electron, the atom is changed into an atom of a different kind. These transformations go on until another element is obtained, which is no more radioactive. The theory of these transformations is a very important achievement of Rutherford and Soddy.

For any radioactive element the proportion of atoms destroyed in a given time always remains the same. The time required for the destruction of half of the atoms is a characteristic constant of the element and is called the period. The shorter this period the shorter is what is called the average life of the element. If this average life is very long, the element may still exist in the earth even if its formation has taken place before the actual constitution of the earth's crust—that is, more than a thousand million years ago. This is the case of uranium and thorium. All the other radioactive elements, including radium, have rates of disintegration too large to enable them to survive geological time and they are present in the minerals only because they are continuously produced by a chain of transformations beginning either at uranium or at thorium.

These chains are named "families" and all members of the family are present in the ancient minerals of uranium and thorium. In these minerals a state of equilibrium has been reached. Radium, for instance, is a product of the disintegration of uranium, and the period being 1,600 years, the quantity accumulated in the ore is a little more than three parts of radium to ten million parts of uranium.

We find the element may be more easily found and isolated if its average life is longer than if its average life is shorter. The quantity of polonium is 5,000 times smaller, polonium being also a product of the series starting from uranium, but with a period of only 140 days, and this explains why we could succeed in isolating radium but not polonium. I even can have the hope that polonium will be isolated in the very near future. The most we have had, and then only once, was a tenth of a milligram of polonium, and several milligrams of some material with which it was mixed, and that was a material which was extremely radioactive, much more radioactive than radium. Of course it was not pure polonium, and the purification has not been effected.

In the series from uranium we have a long-lived radio element, ionium, discovered in this country by Prof. Boltwood and known for being the direct parent of radium. It is an intermedium between uranium and radium. It was produced from uranium and that element could be isolated if only it could be quite free of thorium. To the same series belong actinium, discovered in France by Dr. Debierne. In the same family we find short-lived radioactive gases or emanations and of the products of their transformations. Radium emanation is the most important, because it has been isolated in the pure state and because it has received an important medical utilization. Even if it is short-lived, it nevertheless has been isolated and because it is a gas it is easier separated. Its spectrum has been obtained and determined in the pure state. It can be separated from radium and for several purposes its use is more convenient than that of radium.

In the thorium family we find mesothorium and radiothorium, both produced in reduction plants as byproducts in the winning of thorium. They are also used for many purposes. We have also thorium emanation, which is a radioactive gas.

The end products of both families are helium and at least two kinds of isotopic lead.

The radioactive elements are long-lived or short-lived, and the chemist must consider the evidence to determine whether their life be long as uranium, or if it should be very short, as that of some emanations or some product of their transformations. Every substance of that kind is an element and has definite chemical properties. For that reason it has been possible to introduce these elements in the periodic classification. In Mendeléeff's table all the radioactive elements, which are more than thirty in number, occupy ten places, beginning with lead and finishing with uranium. Of course there are only ten places but there are more than thirty elements. The explanation for this is to be found in that several elements occupy the same place, and these are elements which are called isotopic, having such very similar chemical properties that they can't be separated. From the chemical point of view this classification is entirely satisfactory, because the properties of the elements are just these which can be expected from an element belonging to that special place. The first place, which was a new place, has been occupied of course by radium. No one element was at that place at that time. After the discovery of radium it fitted very exactly in the periodic classification where it belongs by its atomic weight and by its properties. Of the other radioactive elements several came in places which were already occupied by other elements—for example, lead, or uranium, or thorium.

Chemistry of Radioactive Elements

In this way we establish what may be called the chemistry of radio elements. It is a specialized chemistry, but though chemistry in its designation, as far as the means of investigation are concerned, it is all very special chemistry, entirely different from the chemistry of the ordinary elements. The methods of investigation are not at all the same. The quantities of radioactive material are so extremely small that they are absolutely beyond determination by any mechanical method which does not depend on electrical measurements. Quantities of radium which may be detected, for example, are less than a ten-thousandth of a milligram, which is not approached by any mechanical method of measurement. It is because of that that we always measure our radioactive substances by its radioactivity and do not try to weigh it. Therefore this study could be in a way called the chemistry of what is invisible. It is an expression which could be applied to a great part of this chemistry which has been started by the discovery of radium and polonium and achieved by the joint work of distinguished scientists of all the world.

National Lime Association Convention

New Features in Kiln Construction—Chemical Control the Key to Kiln Efficiency—Modern Plant at Rockland, Me.—Standardization—Research—Lime in Water Purification—The Plasticimeter—Chemical Department Accomplishments and Plans

THE third annual convention of the National Lime Association was held at the Hotel Commodore, New York, June 15 to 17. The program covered all phases of the association's activities—lime production problems, extending the use of lime in the construction, agricultural and chemical fields, and details of association work.

New Features in Limekiln Construction

Richard K. Meade read a very interesting paper on new features in limekiln construction.[1] These developments were visualized by a set of lantern slides showing kilns in which the steel shell was replaced by reinforced concrete, the application of hand stokers to shaft kilns, and the installation of rotary kilns at the Eastern Potash Corporation's plant near New Brunswick, N. J. This plant will have a capacity of 1,000 tons of lime a day, limestone being obtained from extensive deposits in Sussex Co., N. J., near McAfee. The lime will be used to treat greensand for the production of caustic potash and a residue which will be used in the manufacture of high-grade building brick.

Chemical Control the Key to Kiln Efficiency

W. D. Mount called attention to a fact which is perhaps not generally appreciated—namely, that the alkali manufacturers using the ammonia soda process are among the most important producers of lime. With the best high-grade calcium stone about 1.2 tons of limestone is required per ton of soda ash. In 1918 the production of alkali in this country was equivalent to 2,500,000 tons of soda ash. Using a conservative ratio of 1.3 tons of limestone, this amount of soda ash would call for 3,250,000 tons of limestone or 1,625,000 tons of lime. The commercial production of lime in 1918 was 3,204,000 tons, from which it will be seen that the lime used by the alkali manufacturers was equal to one-half of that burned for commercial purposes.

It is therefore of interest to consider the methods of lime burning employed in this industry. Being part of a great chemical industry, every phase of this work is under complete chemical control.

The limekilns are usually quite high in proportion to the diameter, ranging from 60 to 70 ft., with an internal diameter from one-sixth to one-seventh of the height. They are operated under induced draft, and coke is used as fuel, being charged direct with the stone. Extreme care is taken in adjusting the ratio of coke to stone and also in the sizing of each—a 6-in. cube represents the normal maximum size for the stone and a 2½-in. cube for the coke. The correct ratio of coke to stone is determined by analysis of the coke and adjustment of the burden (coke to stone ratio) until the maximum volume per cent of CO_2 is obtained consistent with a well-burned lime. The gases are analyzed hourly and temperatures are measured by recording pyrometers. Since both the lime and the CO_2 are used in the process close chemical control is absolutely essential in order to maintain the efficiency of subsequent operations and also to keep down costs.

With a high-calcium, free-burning stone and with coke low in sulphur and containing less than 8 per cent ash, fuel ratios as high as 1 ton of coke to 12 or 13 tons of stone are not uncommon monthly averages. These figures may be compared with the theoretical data for a kiln operating under ideal conditions—that is, cold at top and bottom, continuous discharge, fuel burned in direct contact with the stone, perfect heat conservation.

Taking the heat of decomposition of $CaCO_3$ as 775 B.t.u per lb., 1 ton of limestone will require 1,550,000 B.t.u. The average temperature of the stone as charged will probably approximate 50 deg. F. and its specific heat 0.22, hence the temperature range is $1904 - 50 = 1,854$ deg., and the heat required to bring the stone to the decomposition temperature is $1,854 \times 2,000 \times 0.22 = 816,000$ B.t.u. The total heat required is thus 2,366,000 B.t.u. One ton of coke will yield on burning 29,000,000 B.t.u., or enough heat to decompose 12.26 tons of stone under ideal conditions.

It will be noted that results obtained by the alkali manufacturers as regards fuel economy are apparently in excess of those indicated under the ideal conditions assumed. However, it may be pointed out that the stone charged will probably average 95 per cent $CaCO_3$ and that the decomposition is only about 95 per cent complete, so that we have $13 \times 0.95 \times 0.95 = 11.73$, indicating a kiln efficiency of 96 per cent.

Modern Plant at Rockland, Me.

George B. Wood, president of the Rockland & Rockport Lime Corporation, described the company's new plant which is nearing completion at Rockland, Me.

The plant comprises a battery of six Mount kilns with two Morgan mechanical producers centrally located. Provision has been made for the subsequent erection of two additional kilns at each end to make a future battery of ten. The kilns are 10 ft. outside diameter and 75 ft. high above foundations. The top 20 ft. of the kiln is unlined and holds a reserve storage of 45 tons of rock, which is charged through an air-tight charging bell operated by compressed air. Air for combustion is drawn from the bottom of the kiln through the hot lime below the fires, preheating the air before meeting the gas and thoroughly cooling the lime before it discharges from the kiln. The lime discharges continuously through an annular opening at the bottom of the cooling cone onto a slowly revolving circular table. The speed of the table determines the rate of discharge and may be regulated for each kiln independently through the simple shift of a lever.

A conveyor carries the lime to the storage and packing building, where it is first run over a bar grizzly to separate the fines. The lump lime is then sorted by

[1]Some of the features were covered by Mr. Meade in the series of articles which appeared in CHEM. & MET. ENG., vol. 23, p. 841, Oct. 27, 1920; p. 873, Nov. 3, 1920; p. 929, Nov. 10, 1920.

hand into selected lump lime and common lime. Four 500-ton overhead steel storage bins keep the lime in first-class condition until ready for shipment or packing.

Standardization

The luncheon address on Wednesday was delivered by Dr. S. W. Stratton, director of the Bureau of Standards. He spoke on the relation of standardization to Government research and industrial development.

Standardization is essential to the intelligent use of materials, and the development of specifications or standards of quality is particularly important in this connection. Before the process of standardization can begin a set of definitions must be formulated and accepted by all concerned. Then in making the specifications it should be borne in mind that three groups are involved: Those who make the materials, those who use the materials and those who made the specifications. No one of these groups should attempt to draw up specifications without consulting the others. In bringing together the user and the manufacturer, the Bureau of Standards has found that many of the disputes which arose over matters of sentiment or tradition could be solved conclusively in the laboratory.

The Business Outlook

On Thursday the luncheon address was given by Wallace A. Booth, vice-president, Guaranty Trust Co., New York City. Mr. Booth reviewed recent developments in this country and abroad and from this very comprehensive survey of factors influencing business drew the conclusion that the prospect for a steady return to normal conditions is decidedly more hopeful than it was a year ago.

Dependence of Modern Industry on Research

Dr. Arthur D. Little discussed the dependence of modern industry on research, with special reference to the lime industry. He introduced the subject by a very entertaining summary of the wide variety of forms in which calcium carbonate is found in nature—the transparent calcite or Iceland spar used for optical purposes, marble, pearls, and the great limestone, chalk and coral formations which are due to countless millions of minute organisms, particularly foraminifera, globigerina, and the coral polyps.

Turning to lime manufacture, Dr. Little pointed out that the industry was already indebted to science for more than 60 per cent of its market. Many of the problems which still confront the lime burner will be solved by science. Improved kiln design is dependent upon the application of physico-chemical principles, and the quality of the product must be controlled by chemical and physical tests. Different lines of the same chemical composition exhibit wide variations in their physical characteristics. Thus some high-test limes are found to be only 80 per cent available when used for causticizing; in making bleaching powder one lime may absorb 25 per cent more chlorine than another of the same chemical composition, and similar variations are found in practically all of the applications of lime. For certain purposes the little-understood property of plasticity is of prime importance, and Dr. Little called attention to the work that was being done on this subject by Warren E. Emley at the Bureau of Standards and Prof. Bingham at Lafayette.

The progress which has been made in kiln construction is an excellent example of the practical value of research. Old-style kilns produced probably not more than 2 tons of lime per ton of coal, while the ratio in modern kilns is greater than 6: 1.

Lime in Water Purification

Certain phases of the use of lime in water purification were taken up by C. Arthur Brown of the American Steel & Wire Co. Eighteen years' experience with the lime:ferrous sulphate method of water purification has convinced Mr. Brown that this application is capable of considerable extension. At present about 120 municipal water-purification plants in the United States consume 55,000 tons of lime per annum. It is estimated that between 30 and 40 per cent of the water-purification systems in the country could use lime profitably. Projecting the consumption curves forward, this would mean a demand for 346,000 tons of lime in 1931. However, an approach to this figure can be attained only through an educational campaign designed to increase public appreciation of the value of soft water for domestic purposes.

Plasticimeter

Since 1910 the Bureau of Standards has experimented with many types of apparatus for the measurement of plasticity and twenty-one different machines have been built. The latest step in this evolution was demonstrated by Warren E. Emley. This plasticimeter gives a numerical result and is thus more suitable for obtaining comparable records than the Carson blotter test.

Sufficient water is added to the sample to make a good workable mix. A cylinder of the mixture 1½ in. high x 3 in. in diameter is placed in the machine between a specially prepared base plate having a definite absorptive value and a disk which is free to turn but cannot move upward. The absorbent plate rests on a permanent base plate which is simultaneously rotated and elevated by means of suitable gearing. As the base and specimen turn, the friction of the specimen on the disk causes it to turn and this motion winds up a cord attached to a pendulum. The maximum force developed is measured on a scale attached to the pendulum and from this figure and the time required a plasticity figure is calculated.

Samples of hydrate were sent to several plasterers with the request that they rank them according to plasticity as determined from practical test. In every case their opinions checked the results which had been obtained by the plasticimeter. The machine has thus demonstrated its value as a means of distinguishing masons' hydrate from finishing hydrate.

Chemical Department Accomplishments and Plans

Dr. M. E. Holmes, manager of the chemical department of the association, reviewed the work which had been done during the year and the plans for the future.

The chemical uses of lime have been neglected and the problem of extending present uses and developing new ones offers many opportunities for interesting and profitable research. Rapid strides in this direction are being made through studies at the association's laboratories and through co-operation with university, industrial and Government laboratories. During the year the chemical department issued Lime Brief 250, "Outline of the Process of Lime Manufacture," which includes an excellent flow sheet. It is planned to follow this with a brief on the distribution of the uses of lime in agriculture, construction, and over 100 chemical industries.

Meeting of the New Jersey Clay Workers

Report of the Summer Joint Meeting at Trenton, N. J., of the New Jersey Clay Workers' Association and Eastern Section of the American Ceramic Society, June 17, 1921

THE regular summer meeting of the New Jersey Clay Workers' Association and Eastern Section of the American Ceramic Society was held at Trenton, N. J., on Friday, June 17, with morning and afternoon sessions. As in the case of previous years, the Trenton Country Club was selected for the gathering, and there is no doubt that this choice is a happy one in making for a delightful environment for the event.

With President Abel Hansen in the chair, the meeting was called to order close to 11 o'clock, and getting right down to business, Charles Howell Cook, chairman of the executive committee of the association, was called upon for a report relative to the new ceramic school and research station at Rutgers College.

Mr. Cook said that the contract had just been awarded to the Franklin M. Harris Co., Philadelphia, Pa., for the erection of the building, at a price of \$73,877, and ground will be broken at an early date. Other contracts for plumbing, heating, lighting, etc., also have been let, including an award to the New Jersey Terra Cotta Co., Perth Amboy, for terra cotta at a price of \$6,955. The total appropriation of \$100,000 granted by the State Legislature will be absorbed in the construction, and contributions aggregating \$25,000 are expected from the different manufacturers of ceramic products in the state to provide necessary materials as well as proposed equipment. Mr. Cook made an urgent plea to interest the young men of the state in the new ceramic school building and the opportunity to be presented for instruction in ceramic engineering under the direction of Prof. George H. Brown.

The first paper on the program was by William Burgess of the United States Potters' Association on the subject of the tariff, and through necessary absence at Washington, the paper was read by R. H. Minton.

Setting forth that tariff revision, at best, is a difficult matter, Mr. Burgess explained that from first-hand knowledge gathered upon visits to England, France, Germany, Austria, Holland, Belgium, Japan and China, he has been impressed with the urgent need for a fair tariff to protect the pottery industries of the United States. Not only do low wages prevail in these countries, but conditions under which goods are produced are decidedly different from those here.

With a wage scale of 70c. an hour in the United States, those in the various other countries mentioned are: Great Britain, 18c.; France, 15c.; Holland, 13c.; Germany, 6 to 7c.; and Japan, 4 to 5c. While women are employed in the pottery industry in the United States, largly in the decorating shops, the aggregate is about one-third of the total number of operatives. In England it is one-half, and in Germany and central Europe about two-thirds. In these countries the women do much of the heavier work, such as placing kilns and the like, handled in the United States by men.

In Japan, in addition to the employment of a large number of women, many small boys are engaged, largely in decorating work, at a very nominal wage. Even the best of Japanese workers, such as may handle the big jigger, receive at the maximum 85c. a day of twelve hours, while the women earn from 20 to 25c. a day.

Explaining in detail how goods were being brought into the United States with low duty, through invoicing at about one-half the proper value, Mr. Burgess urged a basis for assessing duties so that the American wholesale selling value will be taken in place of the foreign market value, and said that the present Ways and Means Committee at Washington was giving serious consideration to such a plan.

In conclusion, he set forth that it is not the desire of any of the pottery manufacturers to prohibit the importation of foreign ware of any kind, but so to hold it in check that the American producer can obtain a fair share of the market. Previous to the outbreak of the

war the United States did not supply more than 45 per cent of the consumption of this country; during the war period the pottery industry developed under extreme pressure so that up to six months ago the United States manufacturer was supplying upward of 60 per cent of the demand.

Hollow Building Tile

The second and concluding paper of the morning session comprised a short illustrated talk on the subject of "Hollow Building Tile," by Walter A. Hull, Bureau of Standards, Washington, D. C.

He spoke of the work now being conducted at the bureau to ascertain the different characteristics of hollow building tile, the operations being carried out in close co-operation with the Hollow Building Tile Association and its different members. He pointed out that the matter of fire resistance of hollow tile was one of primary importance, and showed a number of lantern slides illustrating the tests for this work at the bureau.

Again, consideration has been given to the relation of fire resistance to other physical properties of the material, such as absorption, strength at different temperatures, expansion, etc. With substantial and encouraging progress being made, he said that the end would be the placing of the industry upon the right footing with respect to other building commodities. This is the big goal that is sought.

Factory Preparation and Burning of Whiteware Bodies

Following an enjoyable luncheon, the larger part of the afternoon session was given over to a highly interesting and illuminating talk by Prof. A. S. Watts, Ohio State University, Columbus, on the subject of "The Factory Preparation and Burning of Whiteware Bodies."

The topic was treated at great length, dealing with the work in its different stages, as (1) raw materials; (2) mixing the body; (3) preparation of stain; (4) equipment; (5) setting the kiln; and (6) firing the kiln. With respect to the grinding of raw materials, he said that fine grinding reduces the amount of feldspar and ball clay, which should improve the color of the ware. With respect to the frequent question, "Does fine grinding cause cracking?" he said that this is a disputed subject, but the raw body is made more dense, which may cause cracking. If the ball clay can be reduced, the tendency to crack should be reduced. The European porcelains do not contain any ball clay.

To clean dirty ball clay properly, Prof. Watts said that it should be dried at not over 100 deg. F., and then plunged into nine times its weight of water. After that, it should be screened through a 150-mesh sieve, and used on a stop weight basis.

With respect to mixing the body, he said that the best practice was to introduce the ball clay slip into a large ball mill, with one-third charge of pebbles; then add the feldspar and flint. Add additional water, if necessary to make a thin slip. Then grind two to three hours; add stain and china clay, and grind to point of mix only.

Mr. Watts gave a number of interesting references at this point with regard to cobalt stain in whiteware bodies. He spoke about the faulty methods of adding cobalt, resulting in a blue gray cast when the body is hard fired. The correct preparation of stain from cobalt sulphate was explained, and the adding of the stain to the body. Reference also was made to the proper proportions of stain to the body, and the use of stains in glazes.

With regard to equipment, he compared rotary and shaking sieves, pointing out the features of merit of the different types. Slip pumps and compression tanks were then considered, and he urged that pumps should not be operated at too high speed.

In the matter of filter presses, it was pointed out that maximum pressure for a good working body was an item of much importance. He recommended that this be 80 lb. for a body free from ball clay, with an addition of 2 lb. for each 2 per cent of ball clay present. For instance, a 100-lb. pressure for a body containing 10 per cent ball clay; 110-lb. pressure for a body with 15 per cent of ball clay, and so on. When the press stops running water, the pressure should be increased 10 lb. for a few minutes before opening the press.

Speaking of the aging of clay and its effect, Mr. Watts said that this develops plasticity by fermentation. Aging causes fine gas cavities, and accordingly is not to be recommended for electrical porcelain production. The clay cellar should be maintained at a temperature above 80 deg. F. and 90 per cent relative humidity.

Dealing with the subject of pug mills, it was brought out that for every body there is only one satisfactory rate of travel through any given pug mill with a given size and shape of outlet. A slower rate produces an open body, and a faster rate produces a granular weak body, due to the friction in the mill. The control is by the regulation of the number of knives in the mill and the slope of the knife blades. All blades should slope the same, for if the top knife, for instance, is sloped the most, the lower blades are only a hindrance and cause heating.

In setting the kiln, Mr. Watts said that in his experience the first and second rings should be set 1 in. apart except midway between the cuts, and the inside rings all set 1 in. apart. A 1-in. opening should be left between all rings, and not more than 6 in. should be left between the top bungs and crown at any point.

In updraft kilns, the well-hole should equal the sum of the cross-sections of the flues leading to it. In such case the center ring of saggers can run to 6 in. below the crown if braced properly. In the matter of downdraft kilns, the center of the kilns may be set 12 to 15 in. below the crown, and the burn improved with an opening provided from top to bottom in center.

Speaking of the firing of the kiln, with particular reference to hard fire porcelain, free from ball clay, he said that with the body biscuited, the fire may progress as fast as the coal will burn, maintaining a condition bordering on reduction from the time the kiln is hot enough to develop such characteristic, or from about the tenth hour. For the best results, the fuel beds never should burn low enough to permit air leakage, as a highly oxidizing condition is as dangerous as a condition of extreme reduction, and results in blue and cream ware instead of white. The temperature is dropped fast after finish to an orange red.

Visits to Potteries

The meeting was adjourned about 4 o'clock to allow time to visit local potteries, and automobiles were provided for the members and guests, with choice of selection between the new plant of Lenox, Inc., manufacturer of fine chinaware, and the new sanitary ware plant of the Mutual Potteries Co.

Meeting of Society of Testing Materials at Asbury Park

Sulphur or Phosphorus Limits Raised on Structural Steel and Steel Castings—Tentative Standards for Metallographic Testing of Iron and Steel Proposed—Impact Testing Given Special Consideration in Session on Steel and Wrought Iron

ABOUT six hundred members of the American Society for Testing Materials unsuccessfully attempted to dodge the prevailing hot wave by assembling at Asbury Park last week. Unfortunately the breeze was from the land most of the time, and the summer is too young to have tempered the frigid Atlantic. Nevertheless the usual number of committee meetings and general sessions drew a large attendance.

Sulphur and Phosphorus in Steel

The committee on steel presented a voluminous report recommending changes or additions to forty-four standards, mostly in an attempt to remove ambiguity from the existing wording or to permit acceptance of steel made by duplex or more complicated processes. Furthermore, the note regarding sulphur and phosphorus limits was removed on ten of the fourteen specifications on which it yet remained.

It will be remembered that due to the difficulty in getting low-sulphur fuels and melting stock and the increasing scarcity of low-phosphorus ores, a war emergency measure was passed by the society, temporarily increasing the limiting percentages 0.01 per cent on a considerable number of standards. It was stipulated, however, that this was done merely to enable the large volume of steel required for war purposes to be produced within recognized specifications, and the original analyses would be restored with the passing of the emergency. Consequently a year ago the note was removed from all but fourteen of the standards, these fourteen, however, including the "tonnage materials" —rails, structural steel, rivet material and tubes.

Meanwhile an ambitious program of experiments had been begun by a joint committee of interested organizations (of which the Society for Testing Materials was one) to determine the effect of residual sulphur and phosphorus in otherwise normal open-hearth rolled steel products. It was felt that this investigation would supply numerical and precise data, which are now almost wholly missing from the literature, on the specific effect of these elements; numerical data which would enable the society to decide intelligently whether it would be safe to permit a permanent increase in sulphur and phosphorus tolerances. Owing to the great amount of work which this joint committee has laid out, its findings have not yet been completed, notwithstanding vigorous prosecution of the tests. It is understood, however, that those on rivet steel (sulphurs ranging up to 0.17 per cent) have been completed by the Watertown Arsenal and the Naval Experiment Station, and will be published by the Bureau of Standards as soon as they can be collated and analyzed.

Both Limits Extended

In view of all the facts, however, the committee on steel decided that it would involve no danger to extend permanently the sulphur limits from 0.05 to 0.06 per cent on structural steel for locomotives, cars and ships, owing to the heavy tonnages involved and to the continued difficulty in obtaining low-sulphur fuels and melting stock. Phosphorus and sulphur were both extended 0.01 per cent for steel castings, for the same reason. It is worthy of remark that the sulphur limit is now reduced on all materials which are to be worked hot (rivets, tubes and chain) and increased on structural materials which are to be fabricated cold.

Steel Rails

A proposal for a new tentative specification for "special quality" rails, closely following those recently adopted by the American Railway Engineering Association, was under consideration. This would be an addition to the present standard—a second specification which should be favored by heavy traffic railroads. However, the steel committee refused to recommend its adoption, in view of very diverse opinions on the manufacturing minutiæ responsible for sound rails and the doubt as to whether the more rigid test requirements would produce rails which would unquestionably stand severe traffic more successfully.

Tests of Steel at High Temperatures

Much interest was shown in the paper by R. S. MacPherran on "Comparative Tests of Steels at High Temperatures" published on page 1153 of this issue. Albert P. Spooner of the Bethlehem Steel Co. described some work in progress in that company's laboratory, quite independent of that by Mr. MacPherran but with a very similar instrumental equipment. He gave some curves from both laboratories, plotted in comparison, which showed substantial parallelism, the difference being easily accounted for by minor differences in chemical composition or previous treatment. Nearly all the curves for tensile strength show a valley between 200 and 400 deg. C. (an occurrence which has not yet been given a rational explanation) and a peak between 600 and 800 deg. C., usually higher than the strength at room temperature, and then on higher temperature a very sudden drop. Reduction-of-area curves are quite generally opposite, showing minima where those for tensile strength have maxima. Mr. Spooner also noted that high-alloy steels broken at elevated temperatures appeared as if they had been burned, but microscopic examination showed that this was not the case; however, fracture in those cases was intercrystalline.

H. J. French called attention to work of several former investigators on this subject, and pointed out that the maxima in the tensile strength curves had been found at a considerably lower temperature than those reported by Mr. MacPherran. In view of the difficulty of producing a zone of uniform temperature, even without the effect of large masses of metal conducting heat out the ends of the furnace at a rapid rate, he recommended that a special study be made to determine whether there was not uniformly plus error in the recorded temperatures.

Atmospheric Corrosion

Committee A-5 on corrosion of iron and steel reported that the test on uncoated sheets exposed in the Pittsburgh district for the last five years is nearing completion.

"The results of the observations at the Pittsburgh tests have now reached a point where we may definitely conclude that copper-bearing metal shows marked superiority in rust-resisting properties as compared to non-copper-bearing metal of substantially the same general composition, from which superiority we may truly anticipate a marked increase in the service life for copper-bearing metals under atmospheric exposure of uncoated sheets.

"It is interesting to note in this connection that the A and O groups of sheets, the light gage non-copper-bearing bessemer and open-hearth metals, which failed first at Pittsburgh, have also failed first at Fort Sheridan, which would indicate that the two different atmospheric conditions have shown substantially the same general tendencies, only with varying rates of corrosion."

A summary of results of the Pittsburgh tests follows. It should be noted that iron or steel containing less than 0.15 per cent copper have been classed as "non-copper bearing." Also that no 16-gage sheet containing 0.06 per cent copper or more has failed. In other words, of 175 16-gage sheets analyzing 0.06 copper or more, not one has failed in Pittsburgh atmosphere after 52 months' exposure. Of 83 16-gage sheets analyzing 0.3 copper or less, 54, or 65 per cent, have failed:

Type Designation	Gage	Number of Groups	Total Number of Sheets	Number Failed	Total Failures at Each Inspection, Expressed as Percentages of Total Sheets of Each Type Exposed: 10 Mo.	16 Mo.	22 Mo.	28 Mo.	35 Mo.	41 Mo.	46 Mo.	52 Mo.
Copper-bearing	16	14	132	None	....	....	....	....	....	....	....	....
Non-copper-bearing	16	11	126	54	None	None	None	10.3	15.9	26.2	32.6	42.9
Copper-bearing	22	15	146	93	None	None	1.4	4.1	13.7	27.4	44.5	63.7
Non-copper-bearing	22	11	84	82	None	35.7	79.7	91.6	94.0	96.4	96.4	97.6

Before starting the Pittsburgh test, pieces were sheared from the edges for preservation. Small rectangles were later cut from these trimmings, and immersed in water pumped from the Calumet mine containing much sulphuric acid, iron and aluminum sulphates. Failure was reported after ¼ in. indentation from the edge, or a perforation. Results on 16-gage sheets are tabulated below:

	Average Life in Days: Copper Greater Than 0.15	Copper Less Than 0.15
Bessemer steel	124	135
Open-hearth steel	113	114
Pure iron	99	124
Wrought iron	128	158

"In the imsersion tests under the conditions which prevail at the Calumet mine, the presence of copper would indicate little influence on the life of the specimen and if any difference, the presence of copper would seem to give a slightly shorter life, also the order of failure of the various groups is decidedly changed, but it would be safer not to draw definite conclusions until we have the finished results of the various atmospheric and immersion tests."

Impact Tests on Cast Steel

"Some Impact Tests on Cast Steel" were presented by F. C. Langenberg. In one investigation a heat of normal steel from a side-blown converter was selected, and half of it poured into a preheated ladle containing a certain amount of 20 per cent ferrophosphorus. Castings were then made from both the normal and the phosphorized steel. Castings were annealed at 950 deg. C. for two hours, air-cooled, and drawn four hours at 500 deg. C. Tests follow:

Mark	Analysis: C	Mn	Si	S	P	Charpy Impact
5775	0.42	0.86	0.20	0.065	0.043	6.69
5775X	0.42	0.86	0.20	0.065	0.104	3.10
5807A	0.42	0.65	0.28	0.069	0.043	5.46
5807B	0.40	0.63	0.30	0.069	0.058	4.65
5807C	0.42	0.60	0.27	0.066	0.068	3.56
5807D	0.41	0.61	0.27	0.065	0.075	2.40

Little difference was noted in the results of the ordinary static tests, except that 5807 D was somewhat lacking in ductility.

A second investigation was on a series of high manganese castings, air-cooled from 900 deg. C. The extraordinarily high impact value of 30 or more was noted from those which analyzed 0.22 to 0.30 C and 1.08 to 1.29 Mn. Higher carbons with lower manganese, or *vice versa*, lowered the Charpy figure greatly.

An acid open-hearth casting containing C 0.30 per cent, Mn 0.62, Si 0.18, S 0.038 and P 0.038 was given three heat-treatments as follows:

A: Quenched in water from 900 deg. C.; drawn two hours at 650 deg. C. and furnace-cooled. *B:* Furnace-cooled from 900 deg. C. *C:* Air-cooled from 950 deg. C., drawn two hours at 500 deg. C. and furnace-cooled. Physical properties follow:

Heat-Treatment	Yield Point	Tensile Strength	Elongation	Contraction	Charpy Impact	Brinell Hardness
A	57,500	87,333	15.3	22.8	14.25	176
B	46,333	79,333	18.3	27.2	11.32	156
C	49,500	82,666	16.2	23.9	11.87	159

C. E. Margerum pointed out that many steel objects intended to resist impact are hardened. Single-blow impact tests on such material are misleading, since hardness (a desirable quality) and internal flaws (an undesirable quality) both reduce the amount of energy necessary to break the specimen. In an effort to translate the foot-pounds at rupture to a force required to break the specimen, the author has devised a simple apparatus, as follows:

A hammer, falling at a controlled speed, strikes a plunger, capable of limited vertical motion, the lower end of which is formed into a yoke, and which transmits the blow to the ends of the specimen. The test-piece is 0.35 x 0.35 x 1.75 in., resting on a central support, which in turn rocks on a hardened 10-mm. steel ball. Supporting all this is a record bar, calibrated with the same ball (after the fashion of the Brinell test) by static pressure. The force existing on the central bearing at the instant of rupture may then be taken from the calibration curve, after measuring the indentation made by the ball. A series of tests on 1.08 per cent C tool steel shows the greatest impact strength after a draw ranging from 570 to 700 deg. C. If the same apparatus is used in a compression machine, holding each increment of load two minutes, the "static strength" is 40 to 60 per cent less for these draws.

Sir Robert Hadfield, Fritz Medalist

IT IS doubtless unnecessary to remind American engineers that the John Fritz award was instituted twenty years ago by the American societies of Civil, Mining, Mechanical and Electrical Engineers, and the first medal bestowed upon its namesake on his eightieth birthday. Designed to perpetuate that genial iron master's achievements in technology, particularly mechanical engineering applied to steel manufacture, it has become the most coveted honor at the disposal of American engineers and has been bestowed upon the following eminent scientists and engineers:

Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas Alva Edison, Charles T. Porter, Alfred Nobel, Sir William Henry White, Robert W. Hunt, John Edson Sweet, James Douglas, Elihu Thomson, Henry Marion Howe, J. Waldo Smith, George W. Goethals, Orville Wright.

During the past year it has been the ambition of the board of award to express the obligation which American engineers feel not only for the terrible sacrifices made by the engineers of Great Britain in the war, but for their great engineering achievements for the preservation of civilization. It ultimately found expression in making Sir Robert Hadfield the next John Fritz Medalist, not only for his personal achievements, especially the invention of manganese steel, but through him, to his brother-engineers. A deputation of representative Americans, including Ambrose Swasey, Ira N. Hollis, Charles T. Main, F. B. Jewett, Christopher R. Corning, Arthur S. Dwight, John R. Freeman and Charles F. Rand, will bear this message of good cheer to the other side, and present the medal on June 29, during the meeting of the Institution of Civil Engineers of Great Britain, in London. Far from a jealous feeling that such an honor should go beyond our boundaries, nothing but good will and cordiality accompany it, and the wish that the problems of reconstruction may be as effectively surmounted as those of the great war!

SIR ROBERT HADFIELD

Sir Robert Hadfield, although born in Sheffield, Yorkshire, in the year 1859, comes from the Derbyshire family of that name who live at Edale. This quaint Derbyshire village is surrounded by the Kinderscout Hills, almost mountains, from 1,800 to 2,000 ft. in height. It is the center described both by Mrs. Humphry Ward in "David Grieve," and Charlotte Brontë in her novel "Jane Eyre." Edale is not far from historic Castleton, celebrated by Sir Walter Scott in his "Peveril of the Peak," with its Mam Tor, Win Hill, the Shivering Mountain, the famous Blue John mine and other fascinating places of historic interest. Chatsworth, Haddon Hall and Rowsley are all within hailing distance, and through these Derbyshire vales flows the well-known River Derwent of Isaak Walton fame.

Young Hadfield was educated at Sheffield Collegiate School, where he obtained in 1874 two scholarships and prizes in natural science. In 1876 he entered the laboratory of his father's works, and at the age of twenty-three discovered the remarkable properties of manganese steel. Another very important invention—low hysteresis steel, which is also saving the electrical trades many millions of dollars annually—was made a few years later. More recent research has been particularly successful in the line of development of heavy armor-piercing projectiles, and light body armor. In 1888 he became chairman and managing director of Hadfields, Ltd., which post he has continuously held. Despite the demands upon a busy executive, he has never lost his keen interest in fundamental metallurgical research. In fact, his important contributions to scientific literature number 128 in all, and cover, often in encyclopædic manner, such subjects as manganese and alloy steels, sound ingots, corrosion, research, physical testing, microscopic and X-ray examinations, ancient and modern metallurgical history, shorthand (Sir Robert makes free use of this method in handling his voluminous correspondence), patents, and the labor question. That his interest in the latter is not entirely academic may be inferred from the fact that he introduced the forty-eight-hour week at the Hadfield works in 1891.

His honorary memberships and fellowships, awards, presidencies, vice-presidencies and degrees are far too numerous to catalog. Among the most notable might be mentioned Master Cutler of Sheffield, 1899-1900; president of the Iron and Steel Institute, 1905-1907; president of the Faraday Society, 1914-1920; Bessemer Medalist and special gold medal from Société d'Encouragement pour l'Industrie Nationale. He received special letters of thanks from the Prime Minister and the French Ambassador for services rendered to the nation during the war, in connection with the Hadfield Hospital at Wimereux, near Boulogne, and for which he was entirely responsible from November, 1914, to January, 1919; during this time no less than 16,300 cases were dealt with; also from the Minister of Munitions (Winston S. Churchill) for services rendered as a member of the advisory panel of the Munitions Inventions Department.

Pipe-Line Transportation of Hot Oil

A Study of Thermal Losses in Hot Petroleum Transit Lines — Calculations Based on d'Arcy's Hydraulic Formula for Spacing Pumping and Heating Stations — Curves of Hydraulic Gradient for Insulated and Uninsulated 8-In. Lines

BY LEONARD L. BARRETT*

IT IS the object of this paper to calculate the effect of applying insulating coverings to hot oil pipe lines such as are found in the California, Texas and Mexican fields, and to deduce the economic results to be obtained by such practice. In order that such calculations may be of value they must be based on correct data and must be in such form that the methods can be followed and applied by engineers who may be called upon to lay out the design of pipe lines. In addition, therefore, to attempting to carry out the main purpose of this paper an effort has been made to compile the results of the best practice in pipe-line design and to elucidate the application of the methods described.

The rate of heat loss from a hot oil pipe line has a governing effect upon the location of stations. As the temperature of the oil drops due to loss of heat by radiation, the viscosity of the oil increases rapidly and a point is reached where it becomes necessary to install a pumping station and heaters to force the oil along. The low specific heat of crude oil, approximately 0.5, accounts in a measure for the rapidity with which the oil drops in temperature during its passage through the pipe line, because for a given loss of heat the temperature of the oil will drop twice as fast as would that of water.

The heat loss from a heated surface varies with the difference in temperature of the surface and the surrounding air. In oil pipe lines where the oil is heated to 170 deg. F. and discharged around 100 deg. F. the temperature difference between the pipe and the air (or earth) will vary generally from 30 to 100 deg. F. In passing through varied country a ditched line unprotected by insulation meets with varied radiation losses.

THERMAL LOSSES IN TRANSIT LINES

The loss from such a line is vastly increased during rainy periods when the ground is full of moisture which leads the heat away from the pipe line by conduction. In such cases it is very difficult to estimate the terminal and intermediate temperatures of the oil in advance of the construction of the line. The use of a suitable insulating covering on the pipe line will in large measure nullify the effect of these variations, thus adding greatly to the reliability of temperature determinations in advance of construction. The chief virtue of such a covering is, however, to be found in the enormous heat saving which is effected. The oil retains its heat much longer and the costly pumping and heating stations which form the principal element of cost in pipe-line construction and maintenance can be spaced considerably further apart. When it is considered that one of these stations costs in the neighborhood of $300,000 this aspect becomes most important. The reason for this saving in heat is to be found in the fact that the conductivity of a 1 in. thickness of 85 per cent magnesia covering per square foot of pipe surface per hour per degree temperature difference averages 0.45 B.t.u. for temperature differences between 25 and 125 deg. F., while the bare pipe loss in air is between four and five times as much and the ditched pipe loss lies between the two and may exceed that in air if the ground is wet.

The questions to be considered are: (*a*) How much further will the heat carry in an insulated line than in a bare line, and (*b*) how much further apart can stations be spaced if the line be insulated? The proper spacing of stations must be determined by the hydraulic formula.

CALCULATION OF THE FLOW OF VISCOUS FLUIDS

The formula we shall use is the d'Arcy formula as modified by Prof. W. F. Durand for use with viscous fluids.[1]

Let u = viscosity in absolute units;
o = density, lb. per cu.ft.;
D = diameter of pipe in feet;
L = length of pipe in feet;
v = velocity, feet per second;
p = loss in pressure head due to friction, in lb. per sq.in.

The formula may then be put in the form

$$p = \frac{fov^2L}{288gD} \qquad (1)$$

where f is a function of $\frac{Dvo}{u}$ defined by $f = \phi\left(\frac{Dvo}{u}\right)$

Prof. Durand has shown that where the value of $\frac{Dvo}{u}$ is less than 2,000 there will be stream line or sinuous flow, and in such case $f = \frac{64u}{Dvo}$. Where the value of $\frac{Dvo}{u}$ exceeds 2,000 there will be turbulent flow and the value of f in such case is given by the following table:

$\frac{Dvo}{u}$	f	$\frac{Dvo}{u}$	f
2,500	0.0442	12,000	0.0304
3,000	0.0426	14,000	0.0292
3,500	0.0412	16,000	0.0280
4,000	0.0400	18,000	0.0271
4,500	0.0390	20,000	0.0264
5,000	0.0382	25,000	0.0249
6,000	0.0364	30,000	0.0238
7,000	0.0350	35,000	0.0228
8,000	0.0340	40,000	0.0219
9,000	0.0330	45,000	0.0213
10,000	0.0320	50,000	0.0208

In order to be on the side of safety in design the value 0.0442 should be taken for f when the value of $\frac{Dvo}{u}$ is 2,000.

It will be observed from equation 1 that the loss of

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[1] *Journal of Electricity*, vol. 44, p. 434. See also article by A. C. Preston in CHEM. & MET. ENG., vol. 23, pp. 607-613 and 685-689.

pressure in any section of a given pipe line of constant diameter will vary with both the viscosity and the density of the oil in that particular section. It will not do to assume a constant viscosity and density throughout the length of the pipe line, as both these quantities vary with the temperature of the oil and the temperature is dropping continuously as the oil proceeds from one pumping station to the next. The viscosity, particularly, increases so rapidly as the temperature is reduced that we have very different conditions in the various sections of the same line. For these reasons the loss of head will be computed from point to point along the line. The variations referred to may give rise to such pronounced effects that while we may have turbulent flow at the beginning of a line where the oil is warmest, a point will be reached further along the pipe where the flow will become stream line in character as the temperature decreases and the viscosity rises. An example of such a case will be given later on.

Spacing of Pumping Stations

The following steps are necessary for the solution of the question regarding the spacing of stations. They are:

(1) The construction of a curve showing the temperature of the oil as a function of distance traveled.

(2) The construction of curves showing the viscosity and density of the oil as a function of distance traveled.

(3) The construction of curves showing the values of $\frac{Dvo}{u}$ and of f as a function of the distance.

(4) The construction of a curve showing the pressure in the pipe line as a function of the distance. This curve gives the hydraulic gradient. The point of intersection of the hydraulic gradient with the line representing zero pressure gives the location of the next pumping station if the elevations are equal.

Temperature of the Oil During Flow

Let us now develop a formula for the determination of the temperature of the oil at any point in the pipe line, as it is on this determination that all subsequent work must be based.

Let V = velocity of oil, feet per hour;
L = length of pipe, feet;
t = time required for oil to pass through L feet of pipe, hours.
w = weight of oil in 1 ft. of pipe, pounds;
T = temperature of oil at beginning of length L;
T' = temperature of oil at end of length L;
T'' = mean temperature difference between oil and air in length L;
k = specific heat of oil = 0.5;
T_o = temperature of air;
Q = quantity of heat radiated from pipe of length L in time t;
a = radiating surface of 1 ft. length of pipe, in square feet;
t' = thickness in inches of an insulating covering on a flat surface which will give the same thermal resistance as the thickness of the same material which is used on the given pipe, or the equivalent thickness of the insulating material if applied to a flat surface;
c' = conductivity of 1 in. thickness of insulation in B.t.u. per sq.ft. per hour per degree temperature difference between pipe and air;
R' = radius of outside of pipe in inches;
R'' = radius of outside surface of insulation in inches;
c = radiation from bare pipe, B.t.u. per sq.ft. per hour per degree temperature difference between pipe and air.

The radiation from L feet of bare pipe in time t will be

$$Q = acT''Lt \qquad (2)$$

As the wL pounds of oil contained in the L feet of pipe will lose this same amount of heat in the time t, the temperature of the oil falling from T to T', we may also write

$$Q = wLk(T - T') \qquad (3)$$

Equating these values of Q, substituting for t its value $\frac{L}{V}$, and solving for L, we have

$$L = \frac{(T - T')\,Vwk}{acT''} \qquad (4)$$

$$\text{Also, } T'' = \frac{T - T'}{\ln\frac{T - T_o}{T' - T_o}} \qquad (5)$$

$$\therefore L = \frac{Vwk}{ac}\ln\frac{T - T_o}{T' - T_o} \qquad (6)$$

Values of T'' and $\ln\frac{T - T_o}{T' - T_o}$ are given in the Table I.

TABLE I. VALUES OF T'' AND LN $\frac{T - T_o}{T' - T_o}$

Initial and Final Temperature of Oil	Temperature of Air: 70 Deg. T''	70 Deg. $\ln\frac{T-T_o}{T'-T_o}$	80 Deg. T''	80 Deg. $\ln\frac{T-T_o}{T'-T_o}$	90 Deg. T''	90 Deg. $\ln\frac{T-T_o}{T'-T_o}$
170 160	96	0.1044	85	0.1177	76	0.131
160 150	85	0.1177	76	0.131	64	0.157
150 140	76	0.131	64	0.157	55	0.182
140 130	64	0.157	55	0.182	45	0.223
130 120	55	0.182	45	0.223	35	0.285
120 110	45	0.223	35	0.285	24.5	0.4055
110 100	35	0.285	24.5	0.4055	14.5	0.6931

Values of c for above-ground uninsulated pipes to be used in formula 6 are as follows (see *Trans.* A.S.M.E., vol. 40, p. 674):

T''	30	40	50	60	70	80	90	100	110
c	1.90	1.92	1.95	1.99	2.03	2.07	2.11	2.15	2.22

From equation 6 we may obtain the distance the oil can be pumped before its temperature falls to T'.

In the case of an insulated pipe, equation 2 takes the form

$$Q = \frac{ac'T''Lt}{t'} \qquad (7)$$

and equation 3 remains the same. The corresponding solution for L gives

$$L = \frac{(T - T')\,Vt'wk}{ac'T''} \qquad (8)$$

Since $t' = R'\ln\frac{R''}{R'}$, and substituting for T'' its value as given by equation 5, we have

$$L = \frac{VwkR'}{ac'}\ln\frac{T - T_o}{T' - T_o}\ln\frac{R''}{R'} \qquad (9)$$

Values of c' for 85 per cent magnesia to be used in

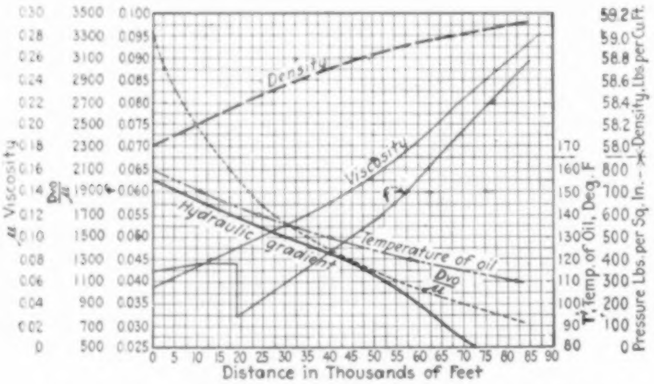


FIG. 1. 8-IN. PIPE LINE, UNINSULATED, DITCHED
25,000 bbl. of 15 deg. Bé. per 24 hr. Initial temperature, 160 deg. F. Initial pressure, 750 lb. per sq.in.

this equation have been carefully worked out from experiments conducted at the Mellon Institute (see *Trans.* A.S.M.E., vol. 40, p. 674) and are as follows:

T''	25	50	75	100	125
c'	0.43	0.44	0.45	0.46	0.47

Temperature-Distance Curves

As a specific example to illustrate the application of formulas 6 and 9 and to illustrate the plotting of the temperature-distance curves, let us take 15 deg. Bé. oil with an initial temperature of 160 deg. F. and being pumped through an 8-in. line at the rate of 25,000 bbl. every twenty-four hours, and let us first determine the distance it will travel through an above-ground uninsulated pipe before its temperature falls to 150 deg. F. We have then

$V = 16{,}740;$
$w = 0.347 \times 58.12 = 20.17;$
$T_o = 80,\ T = 160,\ T' = 150,\ T'' = 76;$
$a = 2.258;$
$c = 2.05.$

Substituting these values in equation 6, we get $L = 4{,}970$ ft.

Now if the pipe be covered with a standard 85 per cent magnesia covering $1\frac{1}{4}$ in. thick, we will have

$c' = 0.45$, and $R' \ln \dfrac{R''}{R'} = 1.1$, which substituted in

equation 9 gives $L = 24{,}000$ ft.

The temperature-distance curves in the figures are plotted in this manner for every 10 deg. temperature difference. The values of c and c' used in each computation must be changed to accord with the value of T''. The values of L given by equation 9 are conservative, as c' gives only the conductivity of the covering and no allowance has been made for the resistance to heat transfer from the surface of the covering to the air. Unless the air circulates so rapidly as to reduce the temperature of the surface of the covering to the same temperature as the air, this surface resistance will be an added resistance to heat loss and the length of pipe traversed by the oil before it reaches a temperature of 150 deg. F. will be somewhat greater than that given by the formula.

Expressed in a different way, we may say that equation 9 gives the length of pipe in which the temperature of the oil will fall from T to T' degrees when the wind is blowing strong enough to reduce the temperature of the outer surface of the insulation to the temperature of the air, which is the only safe condition to assume in a calculation of this sort. Equation 9 is equally applicable to insulations other than magnesia provided the conductivity (c') of such insulation is known.

Calculations for Ditched Pipe Lines

For the case of an uninsulated ditched pipe line equation 6 is to be used. A fair value of c to be used for ditched lines in the formula in this paper is 0.9, which will give a temperature drop of the oil in a given distance corresponding to that found in practice. The corresponding spacing of stations will be slightly in excess of that found in practice (without looping), thus affording a conservative basis for the economic comparisons to be made later on.

This value of c is too low for moist ground, as still water conducts heat about eight times as rapidly as air does. The rate of conduction is much increased if the water has any motion whatever. The fact must always be borne in mind that the value of c for a ditched line will vary with the nature of the ground. This variation is much less pronounced when the line is insulated, providing the insulation is waterproof. Applying the value $c = 0.9$ to the example we have taken and substituting in equation 6, we obtain $L = 10{,}900$ ft.

The case of insulated ditched lines is also handled by the use of equation 6 after the determination of a proper value of c. Assuming that the pipe is covered with a 1.25 in. thick insulating covering of conductivity 0.45 prior to filling the trench and that the heat loss from a ditched bare pipe is 0.9 B.t.u. per sq.ft. per hour per degree temperature difference of pipe and air, the computed value of c which may be used in formula 6 for the case of the pipe covered with the insulating covering and ditched the same distance under the ground is 0.28.

This value is obtained from the rational formula

$$c'' = \frac{1}{\dfrac{1}{c} + \dfrac{t'}{c'}}$$

where c' = conductivity of insulating material per inch thickness per hour per sq.ft. per degree temperature difference between pipe and air = 0.45;

c = heat loss per sq.ft. per hour per degree temperature difference between pipe and air of an uninsulated ditched pipe = 0.9;

t' = equivalent thickness of the insulating material if applied to a flat surface = 1.1 in.

Thermal Efficiencies Obtained in Practice

Taking the efficiency of the system as the ratio of the heat saving due to ditching or covering, or both, to the heat loss in air, the efficiency of the various systems mentioned for a temperature difference of 100 deg.

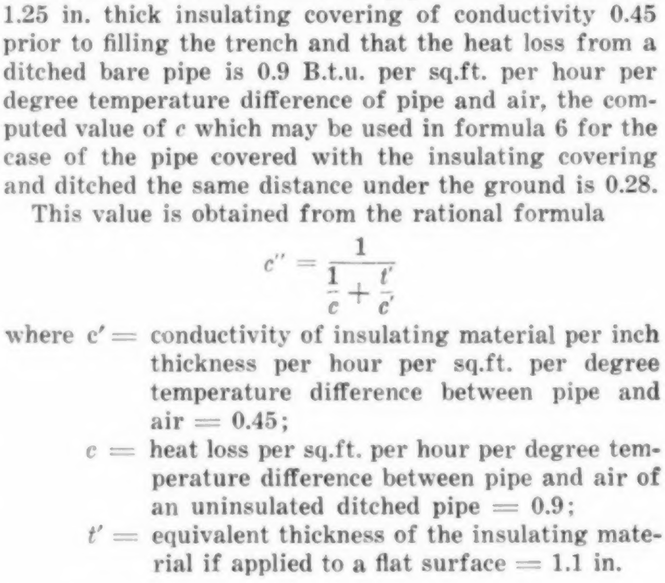


FIG. 2. 8-IN. PIPE LINE, ABOVE GROUND, INSULATED
25,000 bbl. of 15 deg. Bé. per 24 hr. Initial temperature, 160 deg. F. Initial pressure, 750 lb. per sq.in.

between pipe and air will be found by referring to the tables of values c and c' and the value of c'' just determined for ditched lines.

The results are as follows:

(a) for above-ground uncovered pipe the efficiency is 0.

(b) For above-ground 8-in. pipe covered with 1.25-in. thick magnesia the efficiency is

$$\frac{100\ (2.15) - 100\ (0.46) \div 1.1}{100\ (2.15)} = 80 \text{ per cent}$$

(c) For ditched 8-in. bare pipe, the efficiency is

$$\frac{100\ (2.15) - 100\ (0.9)}{100\ (2.15)} = 58 \text{ per cent}$$

(d) For ditched 8-in. pipe covered with 1.25 in. of insulation of conductivity 0.45 the efficiency is

$$\frac{100\ (2.15) - 100\ (0.28)}{100\ (2.15)} = 87 \text{ per cent}$$

Reliability of the C Coefficients

Summarizing what has been said concerning the radiation coefficient, let us consider in turn the reliability of the information given for each type of system. The values of the coefficient c' as given for above-ground insulated lines are very reliable and may be used with confidence. They do not fluctuate except slightly on the side of safety when the wind losses are small. The values of c for above-ground uninsulated lines are reliable and well established. They were determined, however, for still air conditions and would increase for air in motion. The value of the coefficient for ditched uninsulated lines is subject to very large fluctuations according to the nature of the ground and is by far the least reliable. The value of c'' for ditched insulated lines also fluctuates with the nature of the ground, but to a much less extent than the coefficient for ditched uninsulated lines.

The Viscosity-Distance Curve

The viscosity-distance curve is constructed from the temperature-distance curve and from the viscosity-temperature curve of the oil to be handled as determined by a laboratory test with the viscosimeter.

Where viscosities are measured by means of Saybolt times, the absolute viscosity can be found from the formula

$$\frac{u}{o} = 0.00000237t - \frac{0.00194}{t}$$

where u = viscosity in absolute units;
o = density, lb. per cu.ft.;
t = Saybolt time.

If no laboratory determination of the viscosity is available and only the Baumé gravity of the oil is known, the viscosities may be approximated from the following values given by Dyer for California crudes. The curves in the figures are constructed from these values:

Gravity Bé. at 60 deg. F.	18.2	16.6	15	12.1
Density at 60 deg. F.	58.95	59.59	60.26	61.48
Temperature, F.	Viscosity			
75	0.2450	0.4970	1.5670	......
100	0.1220	0.2230	0.3440	......
110	......	......	......	1.6610
125	0.0670	0.0990	0.1500	0.6140
150	0.0365	0.0490	0.0750	0.2110
175	0.0242	0.0245	0.0310	0.1020

The Density-Distance Curve

The density-distance curve is constructed from the temperature-distance curve by the use of formula

$$o = o' - \frac{121.2 - o'}{2713}(t - 60)$$

Where o' = density in lb. per cu.ft. at 60 deg. F.;
o = density in lb. per cu.ft. at t deg. F.

The curve giving the value of $\frac{Dvo}{u}$ as a function of distance is then computed. Glancing at the curve for the ditched uninsulated line, it will be noted that the flow changes from turbulent to stream line at about 19,000 ft. from the beginning of the line, the value of $\frac{Dvo}{u}$ at this point being 2,000.

The Coefficient F Curve

The curve giving the value of f is then constructed by the formula $f = \frac{64u}{Dvo}$ for values of f less than 2,000 and from the table for values of f greater than 2,000.

The pressure curve is now constructed by the use of formula 1 and the curves giving the values of f and o. The pressure drop has been computed and plotted every 20,000 ft., the value of f and o used in each case being the mean values of these quantities for the length of pipe under consideration. Glancing again at the curve for the ditched uninsulated line, it will be observed that the change from turbulent to stream-line flow causes a

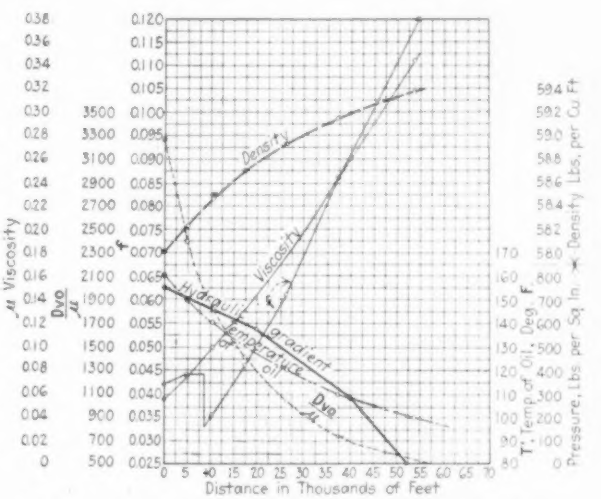


FIG. 3. 8-IN. PIPE LINE, ABOVE GROUND, BARE
25,000 bbl. of 15 deg. Bé. per 24 hr. Initial temperature, 160 deg. F. Initial pressure, 750 lb. per sq.in.

point of inflection in the pressure curve, the curve changing from concave upward to concave downward at this point. In building a line the stations would be spaced a little closer together than given by the curves (assuming no looping or change in pipe sizes) in order to take care of unusual conditions in the viscosity of the oil, in the temperature of the air, and in the moisture content of the ground. As some such correction would be required on all the types of line discussed, although in the insulated lines the pressure drop would increase only due to unusual temperature or viscosity conditions, it follows that the ratio between the computed spacings is about correct and that the spacings found by the curves can be used for the purpose of comparisons of the various systems.

The distance between stations can be increased by adding a "loop" or increasing the pipe size near the end of the line. One of these expedients can always be employed, but they will not be discussed here, as they

do not affect the validity of the results arrived at or of the comparisons to be made.

Discussion of Results

It is apparent from the curves in the figures that under the assumed conditions the stations on the above-ground uninsulated line can be spaced 9.85 miles apart, those on the buried uninsulated line can be spaced 13.73 miles apart, and those on the above-ground insulated line can be spaced 16.57 miles apart.

Let us now consider the economic aspects of the question. The cost of a steam-operated pumping station for 8-in. line was about $150,000 when the report of the Federal Trade Commission on pipe-line transportation was prepared in 1916. The cost now would be about $300,000, and such was indeed the approximate cost of recently constructed stations in Mexico. The annual operating expense and fixed charges per station, including labor, fuel, supplies, interest at 6 per cent, depreciation at 10 per cent, taxes and insurance at 5 per cent, is about $98,000. With stations spaced every 13.73 miles and pumping at the rate of 25,000 bbl. every twenty-four hours, this amounts to 78c. per thousand barrel miles, the cost of transporting one barrel a thousand miles being the unit of cost employed in the pipe-line industry.

With stations spaced every 16.57 miles and the same rate of pumping, the cost will be $64\frac{3}{4}$c. per thousand barrel miles. The cost of $1\frac{1}{2}$-in. thick 85 per cent magnesia covering applied and covered with standard roofing is approximately $3,900 per mile. The cost of ditching a pipe line is about $900 a mile, the cost in 1910 as given by the Federal Trade Commission being $470 per mile.

We may now form our balance sheet. Comparing an above-ground insulated line with a ditched uninsulated line, the stations in the first case being spaced 16.57 miles apart and those in the second case being spaced 13.73 miles apart, then by the use of the insulated above-ground line we have a capital saving in the original cost of stations of $372,000 per 100 miles due to the elimination of 1.24 stations, and a saving in the cost of trenching of $90,000, or a total of $462,000 per 100 miles, as against a cost of $390,000 for the necessary insulation. In addition there is a saving in operating expenses, etc., from the elimination of 1.24 stations per 100 miles, of $122,500 per 100 miles per year, and the 1,000 barrel mile cost for pumping stations is reduced from 78c. to $64\frac{3}{4}$c. The 1,000 barrel mile cost for pipe line is increased by the following charges on the insulation, interest at 6 per cent, depreciation at 10 per cent, taxes and insurance at 5 per cent, repairs at 1 per cent, or a total of $85,800 per hundred miles of line, or $9\frac{3}{8}$c. per 1,000 barrel miles.

The net savings are: a capital saving of $72,000 per 100 miles, an annual saving of $36,700 per 100 miles, and a saving in the 1,000 barrel mile cost of 3.85c.

The balance sheet presented was based on a comparison of a ditched uninsulated line with an above-ground insulated line, for the reason that this appears to be the most conservative and appealing comparison, because the ditched uninsulated line is the type now in general use and because the above-ground insulated line presents the simplest conditions for the application of insulating covering and at the same time gives the steadiest or least fluctuating value of the radiation coefficient.

In addition to the considerations already discussed there is also to be considered the protection of the pipe from electrolysis which is gained by placing it above ground, and the steadiness in operating conditions which is gained by eliminating all the trouble due to moist ground during rainy weather.

Setting a Recording Pyrometer for Cold-Junction Temperature

By Kirtland Marsh*

A recording pyrometer of the deflection or millivoltmeter type, on which it is necessary to set the galvanometer for the cold-junction temperature of the couples connected to it, oftentimes offers considerable difficulty to an accurate cold-junction setting because the lowest graduation on the scale or chart is seldom less than 75 deg. F., while the actual cold-junction temperature is often as low as 50 deg. F. When the cold-junction temperature is higher than the lowest chart or scale division the galvanometer can be set to this temperature as closely as the instrument can be read, but when the cold-junction temperature is lower than the lowest division this setting cannot be made so accurately because there is a scale division on only one side of the setting to serve as a guide.

In many cases very little attention is paid to cold-junction settings; but for those users of pyrometers who endeavor to maintain their equipment as accurate as possible and eliminate all sources of error possible the following method for setting deflection instruments when the cold-junction temperature is lower than the lowest scale division may be of some value:

Disconnect the instrument from the couple and set the galvanometer pointer on the lowest scale or chart division. By means of a potentiometer, Wheatstone bridge or other source of a small variable e.m.f. connected to the instrument deflect the galvanometer an amount equal to the difference between the actual cold-junction temperature and the lowest scale division. With the source of e.m.f. unchanged and still connected to the instrument, reset the pointer to the lowest scale division by means of the zero adjuster. Then when the source of e.m.f. is disconnected from the instrument the zero or cold-junction setting will correspond with the actual cold-junction temperature as closely as the instrument can be read.

For example, given an instrument graduated from 75 to 1,800 deg. F. and a couple the cold junction of which, buried in the ground or in a water-cooled well, is at a temperature of 55 deg. F. With the couple disconnected, set the galvanometer pointer at 75 deg. F. and then by means of a potentiometer connected to the instrument deflect the pointer an amount equal to 75 — 55 deg., or 20 deg., when the reading of the instrument will be 75 + 20, or 95 deg. F. By means of the zero adjuster return the pointer to 75 deg. F. Then when the potentiometer is disconnected the instrument will read 75 — (75 — 55), or 55 deg. F., which is the cold-junction temperature.

Inasmuch as the pointer can be set on a scale division with great accuracy, the error of the final cold-junction setting will be the error of setting the pointer at 95 deg. F., which is less than the error of setting the pointer at 55 deg. F. directly when the lowest scale division is 75 deg. F.

*Aluminum Company of America, New Kensington, Pa.

Comparative Tests of Steels at High Temperatures*

The Tests Recorded in This Paper Were Made to Determine the Comparative Properties of Various Steels at High Temperatures With a View to Obtaining Information as to the Best Material for Use Under Operating Conditions of 600 to 1,000 Deg. F.

BY R. S. MACPHERRAN†

THE following tests were made in the laboratory of the Allis-Chalmers Manufacturing Co. to determine the comparative properties of various steels at high temperatures. The work was undertaken with a view to obtaining information as to the best material for use under operating conditions of 600 to 1,000 deg. F. A large number of these tests were made on sheet metal, turbine blading and other material too thin to allow a pyrometer head to be inserted. It was therefore decided to use for all tests a heating box in which the pyrometer head was practically in contact with the center of the test specimen.

The heating box used was 7 in. square by 9 in. high. The hole in which the test specimen was inserted was 2 in. in diameter and was lined with a core of alundum cement wound with No. 22 gage chromel wire. This wire was wound in two coils, one over the top and one over the lower half of the alundum core. They were connected in multiple. The coils were then covered with alundum cement and the box filled with magnesia. (See Fig. 1.) The couple entered at the top of the box and ran down to such a position that the point was opposite the center of the test specimen. A spring on the outside of the box forced a porcelain rod through a hole and against the base metal couple, holding the point of same against the test specimen. The temperatures were taken by a Leeds & Northrup pyrometer, using a base metal couple. The specimens used had threaded ends and were for the most part 0.505 in. in diameter. All tests were held at constant temperature for fifteen to thirty minutes before pulling. The yield points were taken by the drop of beam only and above 600 deg. F. are very uncertain.

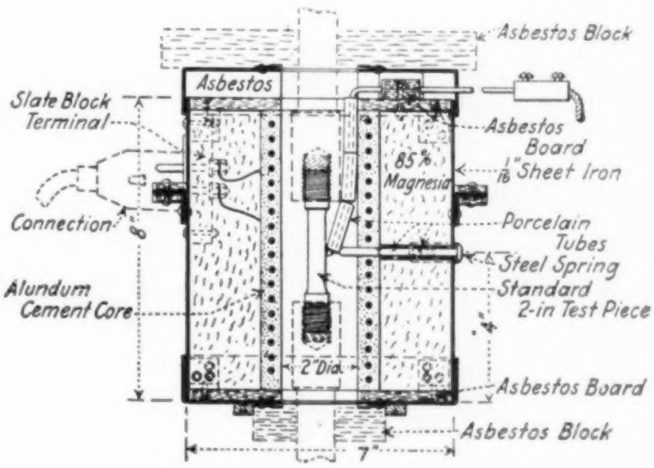
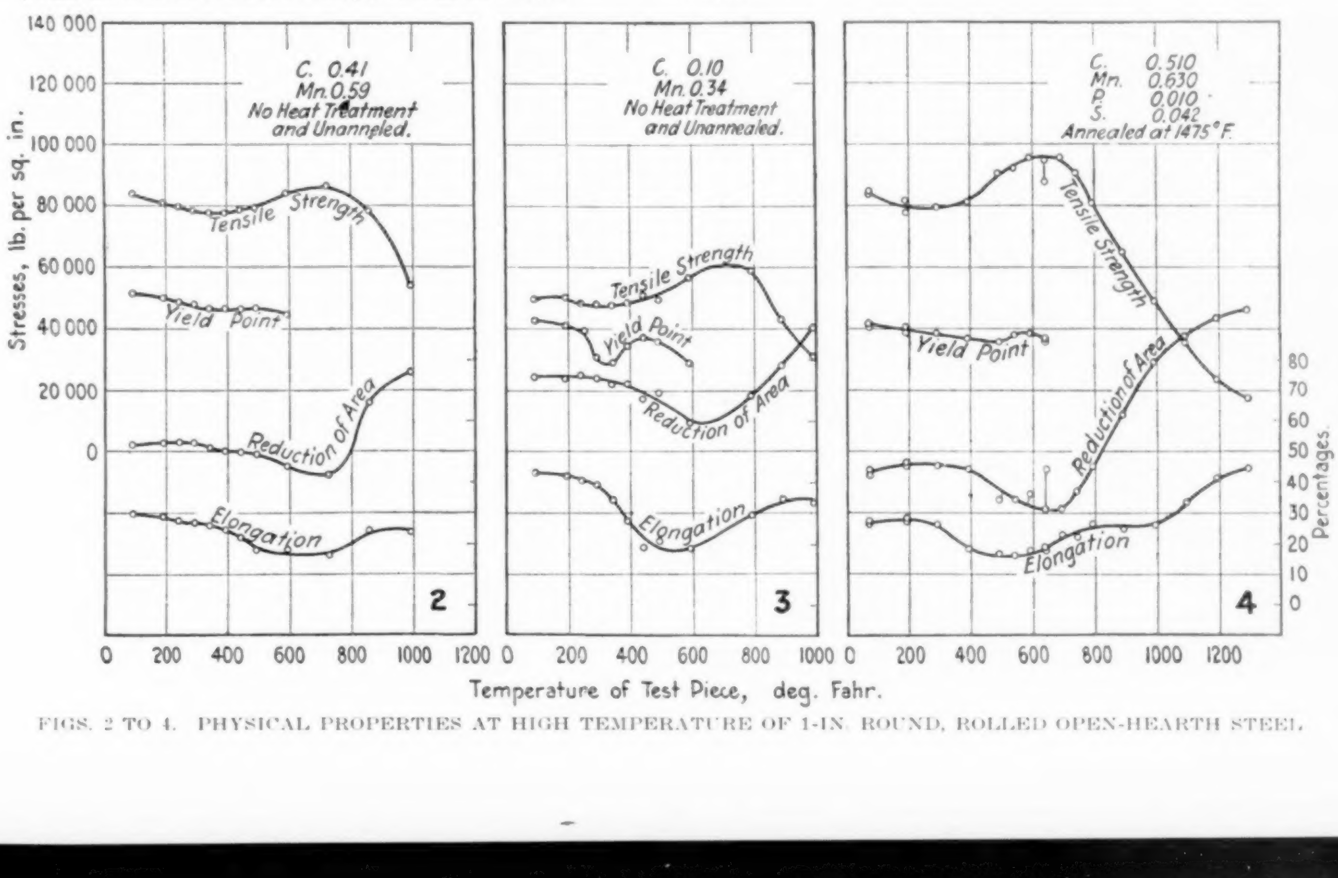


FIG. 1. VERTICAL SECTION OF ELECTRIC HEATER

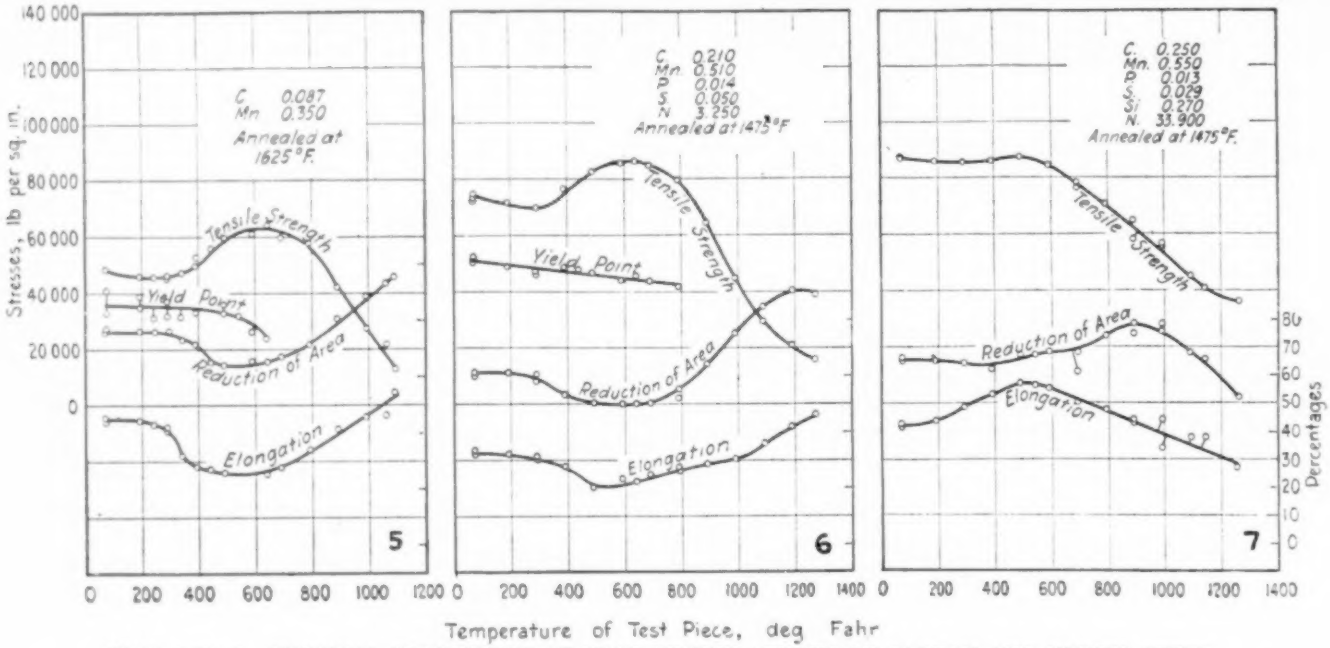
The chrome-vanadium and chrome-nickel steels were quenched and drawn as indicated in the figures. The drawing temperatures are much above the usual, but as the tests were to be run as high as 1,300 deg. F. it was useless to draw the bars at lower than test temperatures.

*Paper read at the meeting of the American Society for Testing Materials, Asbury Park, N. J., June 24, 1921.

†With the assistance of J. F. Harper and E. H. Brown.



FIGS. 2 TO 4. PHYSICAL PROPERTIES AT HIGH TEMPERATURE OF 1-IN. ROUND, ROLLED OPEN-HEARTH STEEL



FIGS. 5 TO 7. PHYSICAL PROPERTIES AT HIGH TEMPERATURES OF CARBON AND NICKEL STEEL
Fig. 5. ¾-in. round, rolled open-hearth steel. Fig. 6. Forged 3.25 per cent nickel steel. Fig. 7. Forged 34 per cent nickel steel.

All forged test-bars in any one series were made from one billet or piece of steel, this being hammered out into several 1-in. rounds about 30 in. in length. These latter pieces were then all heated at the same time in the same furnace and as far as possible given identical treatment. With the best of care, however, the irregularities were greater than with the rolled material tested after annealing, Fig. 8, for example, showing considerable variations in breaking loads. Fig. 9 is from rolled stock sent in by outside parties and was not treated. Figs. 2 and 3 show results of tests on carbon steel, unannealed, and Figs. 4 and 5 on carbon steel, annealed. The latter are freer from irregularities due to lack of uniformity in material and for this reason are more reliable.

While we cannot assume many definite conclusions from our limited number of tests, the following items seem to be at least probable:

1. There is no one temperature at which all steels will show a decided change in physical properties; this point will vary in steels of different compositions or treatments.

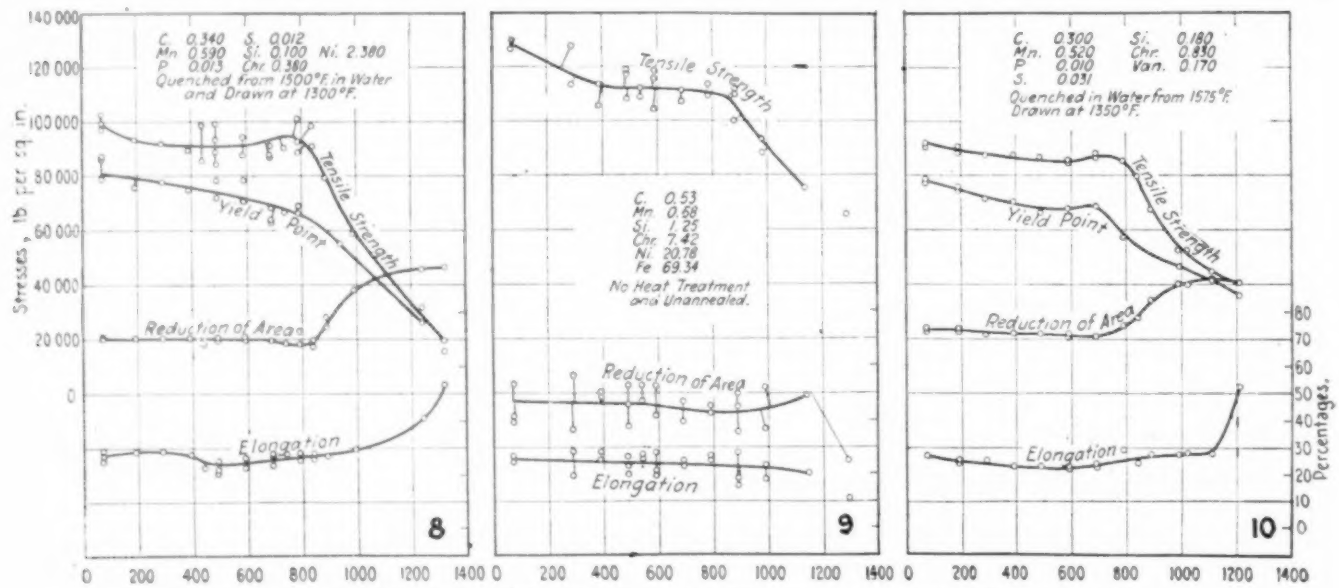
2. The maximum tensile strength for rolled carbon steel, annealed, and forged 3.25 per cent nickel steel, annealed, occurs at between 600 and 650 deg. F.

3. The maximum tensile strength usually occurs at a higher temperature than the minimum ductility.

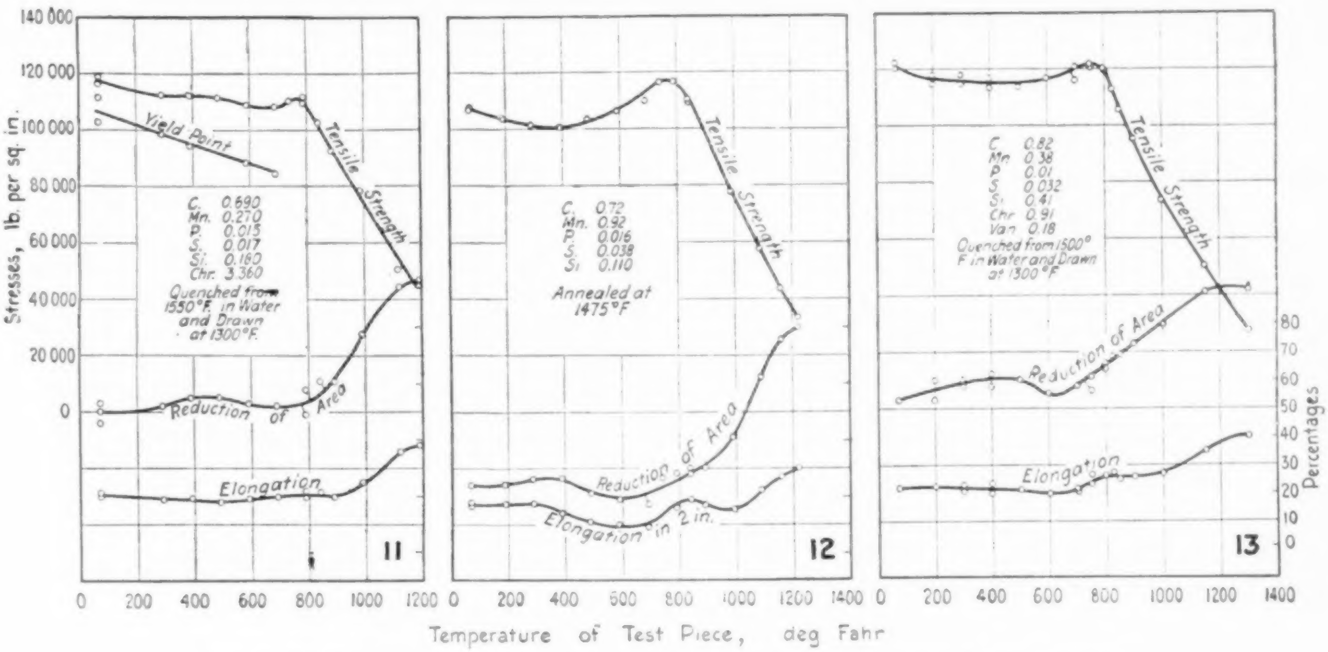
The majority of the tensile strength curves, especially those of heat-treated steels, drop sharply as the temperature exceeds 800 deg. F.

The effect of nickel in small amounts is slight, but in large percentages it tends to lower the temperature at which tensile strength begins to decline. Steel containing nickel is also the only steel examined where the ductility materially diminishes at the higher temperatures. It may here be noted that the same property was observed in the one set we ran of forged Monel metal bars.

The alloy steels containing chromium are less affected by rise in temperature than carbon steels. The curves



FIGS. 8 TO 10. PHYSICAL PROPERTIES OF ALLOY STEEL AT HIGH TEMPERATURES
Fig. 8. Forged chrome-nickel steel. Fig. 9. Rolled high chrome-high nickel steel. Fig. 10. Forged chrome-vanadium steel.



FIGS. 11 TO 13. PHYSICAL PROPERTIES OF ALLOY STEEL AT HIGH TEMPERATURES
Fig. 11. Forged high-chrome steel. Fig. 12. Forged high manganese steel. Fig. 13. Forged high-carbon-chrome-vanadium steel.

of the tensile loads, elongation and reduction all run out more nearly straight than in carbon steels and the maximum loads occur at higher temperatures. It is true that the carbon steels were not heat-treated and it is possible that quenching and tempering would alter the shape of these curves.

The results so far obtained would indicate that the introduction of metals forming carbides tends to strengthen steels at high temperatures.

It is interesting to note that in tests for the comparative retention of physical properties in alloy steels at 1,200 deg. F. and over, Leslie Aitchison[1] finds the order of value to be:

1. Tungsten.
2. High chromium.
3. Nickel, 3 per cent.

It would seem with higher steam pressures and increased use of internal combustion engines that the properties of the various alloy and carbon steels at high temperatures should receive further consideration.

Pulp and Paper Developments in Quebec During 1920

In a report to the Bureau of Foreign and Domestic Commerce on the paper industry of the Province of Quebec for 1920 Consul E. Haldeman Dennison, Quebec, says:

The forest industry holds second place in the province from the standpoint of value of its products, and the Quebec Government last year derived from its forest resources, principally from its pulpwood limits, over $2,600,000, or about 15 per cent of its total revenues.

Quebec continues to lead all Canadian provinces in the pulp and paper industry. Capital to the amount of over $100,000,000 is now invested therein. The annual combined wages of the employees amount to over $10,000,000. The industry consumes over 1,000,000 cords of pulpwood and produces pulp and paper products to the value of upward of $75,000,000 annually, nearly all of which is sold in foreign markets.

The production of pulp and paper in 1920 showed a marked increase over that of the previous year. The price of newsprint at the beginning of 1920 was 3¼c. per lb. and by the end of the year had risen to 6½c.

Several important developments are now under way in the province. They include the erection of new pulp and paper mills at Three Rivers by the International Paper Co., which, when completed, will have a daily capacity of 200 tons of pulp and 200 tons of paper. The Laurentide Co. is installing two new newsprint machines at Grand Mère, with a daily capacity of 350 tons of newsprint and 60 tons of board.

Four new kraft paper machines, capable of producing about twelve tons a day each, are being installed at Three Rivers by the Wayagamack Pulp and Paper Co., which will bring the total kraft production up to 100 or 115 tons a day. This company recently added 2,000 square miles to its timber limits. At Kenogami the firm of Price Bros. & Co. is adding a new 50-ton newsprint machine, increasing its newsprint output to 300 tons daily. The Howard-Smith Paper Mills at Crabtree are adding a new paper machine which will increase their output of high-grade writing paper from their two mills to 100 tons daily.

During the year the Saguenay Pulp & Paper Co. increased its output from 80 to 130 tons a day, while the Brompton Pulp & Paper Co. at East Angus is now constructing a new groundwood mill of 100 tons daily capacity. This company has recently acquired an additional tract of land comprising 90,000 acres, estimated to contain over 1,000,000 cords of pulpwood. The Belgo-Canadian Pulp & Paper Co. is also building a new groundwood mill of 40 tons daily capacity at Shawinigan Falls and making other extensive additions.

At the beginning of 1920 Canadian newsprint mills had a total capacity of 2,775 tons per day, and it is estimated that at the beginning of 1922 this capacity will have increased to 3,245 tons per day and that by 1923 Canada's newsprint production will total over 1,000,000 tons per year.

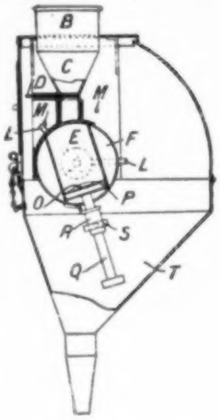
[1]Leslie Aitchison, "Valve Failures and Valve Steels in Internal Combustion Engines," *London Engineer*, Dec. 12-19, 1919.

Recent Chemical & Metallurgical Patents

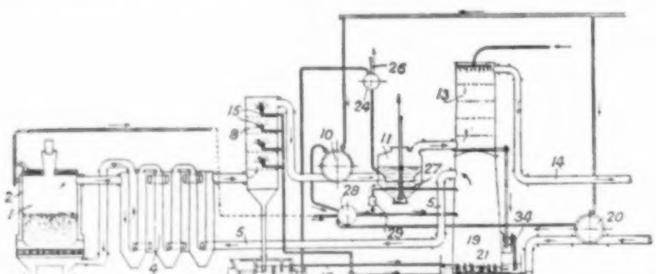
British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Delivering Measured Quantities of Granular Materials.—A device for delivering measured quantities of granular materials, in which an adjustable measuring chamber *E* forming part of pivotally-mounted oscillatory cylinder *F* has an opening which is brought into register with the lower part of a chute *C* communicating with an upper hopper through a chute or tube *B*, has an adjustable piston *O* in the measure *E* encircled by a resilient ring *P* to insure a sliding fit. It is adjusted by a graduated depending stem *Q* secured in position by a clamping screw *S* carried by a bracket *R*. Supplies to the measuring chamber may be cut off by sliding plate *D*. Arms *L* engaging stops *M* limit the movement of the cylinder *F*, which discharges into chute *T*. (Br. Pat. 160,005; J. W. CROWTHER, Darlington, County Durham, May 11, 1921.)



Gas-Producer Plant.—In a gas-producer plant, the air for use in the producer is heated and charged with steam by being brought into contact with water that has been used to remove fixed ammoniacal compounds from and cool the hot gases. The gases leaving the producer 1 pass through a heat-exchanger 4, a chamber 8 having spraying nozzles 15, a tar extractor 10, a saturator 11 and a scrubber 13, finally passing away through a pipe 14. Air under the action of a fan 20 is bubbled through a hot ammoniacal solution by a device 21, passes up the lower part 19 of the scrubber, is mixed with steam, not only from the jacket 2 of the gas producer, but also from the exhaust from the engines driving the fans 10 and 20, this steam passes through a chamber 28, and the mixture of air and steam pass by a pipe 5 through the heat-exchanger 4 to the producer. Water from the nozzles 15 charged with tarry compounds and fixed ammoniacal



salts falls to a receptacle 16, in which tar is separated and the liquor flows by a pipe 18 to the lower part 19 of the scrubber, to be used to supply steam to and heat the incoming air, the liquor then being passed by a pump 22 to the spraying chamber 8. A portion of the liquor is supplied by a liquid-raising device 25 to a receptacle 24, where it is mixed with the sulphuric acid for feeding the saturator 11, hydrochloric acid and the like escaping through a pipe 26. The saturator is steam heated by a coil 27 supplied with steam from the chamber 28, which steam may be superheated in an apparatus 29 burning producer gas. Some of the water from the scrubber 13 passes through an overflow device 34 to the bottom of the lower part 19 of the scrubber. (Br. Pat. 160,151; not yet accepted; SOC. FRANCO-BELGE DE FOURS A COKE, Brussels. May 11, 1921.)

Sodium Bicarbonate-Ammonium Chloride.—In a modified ammonia-soda process, salt and gaseous ammonia are dissolved in a mother liquor containing ammonium carbonate and ammonium chloride, and carbon dioxide, preferably pure and under pressure, is passed into the liquor until sodium bicarbonate equivalent in quantity to the salt and ammonia added is precipitated. The carbonating apparatus is provided with stirring means—e.g. of the Boulouvard type—and also with a cooling system. Although the salt must be dissolved separately, it is advantageous to add some during the carbonation. The sodium bicarbonate is removed and washed and the mother liquor, after the addition of ammonia to convert the ammonium bicarbonate present to carbonate, is run to crystallizers fitted with stirrers and cooling coils. Ammonium chloride is separated at atmospheric temperature or at 5-10 deg. C., and the washing water, etc., having been added to the liquor to maintain its initial volume, the whole process is repeated. Alternately, a solution of ammonium bicarbonate prepared from wash-water by means of ammonia and carbon dioxide may be added to the saline solution of ammonium carbonate, instead of saturating successively with ammonia and carbon dioxide. (Br. Pat. 160,172; not yet accepted; L'AIR LIQUIDE SOC. ANON. POUR L'ETUDE ET L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE, Paris. May 11, 1921.)

Scouring and Leather Dressing Composition.—A composition to be mixed with water to scour leather, with soda solution to scour wool and with oils to dress leather is prepared by mixing a neutralized sulphonated oil such as sulphoricinate of soda or ammonia with an organic solvent, preferably non-flammable. Solvents specified are carbon tetrachloride, tetrachlorethane, trichlorethylene, tetrahydronaphthalene, benzene and naphtha. In an example, 40 parts sulphoricinate are mixed with 60 parts tetrachlorethane. For wool scouring, 1 part of the product is used with 10 of soda, and for dressing chrome leather 4 parts with 2 parts of neatsfoot oil and 2 parts of oil. (Br. Pat. 160,738; not yet accepted; A. T. HOUGH, Choisy-le-Roi, Seine, France. May 19, 1921.)

Purifying Blast-Furnace Gases.—The flammable dust contained in blast-furnace and like gases is oxidized by the admission of a small quantity of air to the gas before purification. The control of the air supply may be co-ordinated with the gas generation in order to prevent the formation of an explosive mixture by closing the air-inlet valve when the main gas valve or the blast valve or damper is closed or by mounting the air supply fan on the shaft of the gas exhauster. Indicating or registering means may be provided for the air supply. (Br. Pat. 160,758; not yet accepted; HALBERGERHÜTTE GES., Halbergerhütte, near Brebach, Germany. May 19, 1921.)

Firing of Ceramic Ware in Tunnel Ovens.—In the firing of ceramic ware in tunnel ovens the heating of the high-temperature zone is interrupted at intervals to allow the goods therein to cool down to a temperature at which they are sufficiently hard to allow the trucks to be moved forward without risk of damage. The gas connections to two adjacent tunnels may be so arranged that their high-temperature zones are fixed alternately. During the interruption in firing the temperature of the preliminary heating zone of the oven is maintained or increased by auxiliary burners. Cooling devices may be fitted in the cooling zone and the heat abstracted may be used for drying. (Br. Pat. 160,814; not yet accepted; ALLGEMEINE ELEKTRICITATS GES., Berlin. May 19, 1921.)

Phosphate Fertilizer.—Natural calcareous phosphates or analogous phosphates, such as bone phosphate, which contain tricalcium phosphate and carbonate of lime, are treated in a rotary furnace with a current of sulphur dioxide, air and steam, at a temperature not exceeding 1,000 deg. C., whereby a mixture of mono- and di-calcium phosphates with calcium sulphate is produced, which is suitable for use as a manure. The presence of a small amount of a chloride, such as calcium chloride, facilitates the reaction. (Br. Pat. 160,847; J. J. MOREL, Grenoble, France. May 19, 1921.)

Current Events
in the Chemical and Metallurgical Industries

Burgess Nominated for Tariff Commission

William Burgess, of Trenton, N. J., prominently associated with ceramic industries since 1879, has been nominated by President Harding to be a member of the United States Tariff Commission. Mr. Burgess is executive commissioner of the United States Potters' Association and prominent in the affairs of the American Ceramic Society. He formerly was a professor of chemistry at Princeton University. His business activities have been devoted largely to the importing and jobbing of china and pottery wares. He is widely known for his public-spirited efforts to be helpful to the entire pottery and other ceramic industries.

For many years he has made a special study of the tariff and has made numerous confidential trips abroad to make studies of the tariff situation for the Government. For a time he was United States consul in the great pottery-producing district of Stoke-on-Trent, England. During the war he was one of the department heads of the War Industries Board.

U. S. Industrial Waste Commission Proposed

A federal commission to study waste elimination in industry is proposed in a bill which has been introduced by Senator Calder. The bill is intended to continue and to amplify the survey made by the Federated American Engineering Societies at the instigation of Herbert Hoover, who at that time was president of the organization.

Senator Calder's bill provides that the commission is to be known as the United States Industrial Waste Commission. It is to be composed of seven commissioners "of eminent attainment," appointed by the President. The bill specifies that the Secretary of Commerce is to be the chairman.

The commission is directed by the bill to make a final report on or before Sept. 21, 1922. The report is to cover waste in "timber, power, transportation, oil, coal, essential minerals and other basic raw materials. The commission is specifically instructed to recommend improved methods and means of eliminating intermittent and seasonal production, and is to serve without salary.

There is reason to believe that the Committee on Commerce, to which the bill has been referred, will take prompt and favorable action on it. The attention of the committee has been called to the fact that needless waste in industry is levying a heavy toll on business and on the public. It is emphasized that no regulation is contemplated in this legislation and that there is not to be a suggestion of interference with private initiative.

It is believed that such a commission will be able to draw public attention to some of the basic causes of waste and to practical methods by which they may be checked.

Irregularity of employment is recognized as one of the matters to which the commission would have to give much attention. The Committee on Commerce, in considering the bill, has before it information to the effect that the shoemaker is idle 35 per cent of his time, the clothing worker 31 per cent. In other industries conditions are even more unfavorable. Data before the committee show that labor, directly and indirectly, is responsible for 88 per cent of the total cost of building. This high labor cost is due, in part, to the fact that in normal years building labor is idle one-third of its time.

The Superpower Survey is cited as an effort to eliminate waste. In the Boston-Washington industrial area about 17,000,000 hp. is being produced. Of this only 10,000,000 hp. is actually productive. The remaining 7,000,000 hp. either is wasted or is used to transport the fuel for the 10,000,000 hp. actually effective. The Superpower Survey is expected to show that the gradual development of an interlocking system of electrical transmission between superpower plants, to which coal could be transported economically, and a gradual development of hydro-electric plants would result in saving most of this 7,000,000 hp. In addition, byproducts could be saved and the transportation system correspondingly relieved. This has been cited to the committee as one example of what may be accomplished along the line of waste elimination.

The committee has also been furnished with data showing that there is great waste resulting from lack of co-ordination of railways, waterways and coastwise shipping, which among other things would relieve the rail lines of much of their burden of low grade, unprofitable freight. Specific instances of waste in coal production, petroleum production, lumber manufacture and many other activities have been pointed out to the committee.

International Standards

The secretary of the American Engineering Standards Committee, Dr. P. G. Agnew, has attended a conference in London of the secretaries of the national standardizing bodies. The conference had for its object an interchange of experience and the furtherance of co-operation among the various national bodies in their work of industrial and engineering standardization.

It is interesting that, notwithstanding great differences in the details of procedure, the same general method of work is followed in the different countries—namely, technical decisions concerning any specific piece of work are in the hands of a working committee which is so constituted as to be broadly representative, from both the technical and the managerial points of view, of the particular branch of the national industry concerned.

Suggestions of the conference have to do with the interchange of publications, a reciprocal arrangement for making foreign standards available and the exchange of information as to the status of work in progress. It was the view of the conference that international co-operation in industrial standardization work should proceed along such informal lines, being based primarily upon the interchange of information on active subjects of mutual interest, rather than by any attempt at the present time to form a general international standardizing body.

Conference on Petroleum Specifications

The Technical Committee on Standardization of Petroleum Specifications plans an open meeting in the offices of the United States Bureau of Mines in Washington, Tuesday, July 12, at 10 a.m. Eastern Standard time, for the consideration of suggested modifications and additions to Bulletin 5, which contains the specifications under which governmental purchases of gasoline, kerosene, fuel and lubricating oils are made.

From the standpoint of the oil trade the most important change proposed is the addition of a corrosion test to the specifications for motor gasoline. Some of the gasoline recently purchased has been found to be corrosive, and a test has been proposed to insure against a repetition of the trouble.

A few new specifications to cover products not now listed in Bulletin 5 have been suggested. Other modifications have been proposed, looking to improvement in the manner of making some of the tests.

N. A. C. Smith, petroleum chemist of the Bureau of Mines, is chairman of the technical committee.

Manufacturing Chemists' Association Annual Meeting

At the annual meeting of the Manufacturing Chemists' Association, the following officers were elected:

President, Charles L. Reese; vice-presidents, H. H. S. Handy and C. Wilton Miller; treasurer, S. W. Wilder; secretary, John I. Tierney; executive committee, Henry Howard, chairman; Adolph G. Rosengarten, Lancaster Morgan, C. Wilbur Miller, D. W. Jayne, H. H. Dow, E. L. Pierce.

The executive committee report for the year ended June 15, 1921, was presented by Dr. Henry Howard. Activities during the year included: Recommendations for tariff revision; arguments against the Federal Trade Commission section of the Nolan patent bill; appointment of a committee to co-operate with Secretary Hoover in collecting statistics on the production of sulphuric acid, nitric acid, soda ash, caustic soda and methanol; investigations at the Bureau of Explosives on a standard package for acid carboys; a conference with the Consolidated Classification Committee in regard to a suggested reclassification of acid shipments.

British Columbia Notes

The B. C. Cement Co. has closed its plant at Tod Inlet, ten miles from Victoria. For some time the plant has been kept in operation by orders from the Orient. With the exception of three or four heads of departments, the plant has been run entirely by Chinese labor. The value of the output of the plant in 1919 was $260,000. The company owns and operates another plant on Vancouver Island.

The Prince Rupert Paper & Pulp Co. has acquired the British Columbia holdings of the North Empire Timber Co. This is one of the biggest timber deals that has been made in the province for some time. The timber area that has been purchased is only a few miles from Prince Rupert, and it is said to contain a billion feet of timber, 90 per cent of which is spruce and hemlock. The North Empire company is controlled in Cedar Rapids and other cities in Iowa.

John Bull, president of the Reliance Paper & Trading Co., which undertook the management of the Whalen Paper & Pulp Co.'s three plants in British Columbia last year, has reported to the directors of the latter company that a saving of $2,500,000 has been made during the past year in the operation of the company's plants. The percentage of No. 1 pulp produced has been increased from an output of 20 to an output of 85 per cent.

The Clayburn Co. has reopened its plant at Kilgard, B. C., where it will manufacture only sewer pipe. Fifty men have been taken on the payroll. The company's Clayburn plant is working at capacity, manufacturing ornamental, pressed, and fire bricks.

A New Mineral

What is believed to be a new mineral, a borate of magnesium, isomorphus with chrysotile, has been found at Douglas Lake, near Merritt, B. C. The mineral occurs in small veins, from the thickness of a sheet of paper up to 5 in., crisscrossing through serpentine. It has been analyzed by H. V. Ellsworth at the laboratories of the Dominion Department of Mines, at Ottawa, and found to contain magnesia, 47.87 per cent; boric acid, 41.44 per cent; water, 10.69 per cent. A physical examination has been made by Eugene Poitevin, who has been unable to classify it as any known mineral, so provisionally it has been named camsellite, after Charles Camsell, Deputy Minister of Mines for Canada, in consideration of the excellent geological field work that he has done in British Columbia.

Robert A. A. Johnston, chief of the Division of Mineralogy of the Federal Department of Mines, speaking of the new mineral, said: "The new mineral is finely fibrous and distinguished only with difficulty from chrysotile, with which often it is intimately mixed. In addition to camsellite, chrysotile and dolomite are always associated with the mineral. The three minerals do not occur in any constant proportion, however—in fact, there are wide differences in this respect in the specimens that have been examined. It has not been found possible to separate camsellite in an ideally pure state, but on the other hand is has been possible to separate both the dolomite and the chrysotile from the specimens, clearly showing that it is only a mechanical mixture of the three minerals."

Patent Office Bill Reported Out by Committee

The bill providing for an increase of force and salaries in the Patent Office has been reported out by the House Committee on Patents with the recommendation that it be passed at the earliest possible date. The bill as reported is substantially the same as the one which passed the House at the last session except that the section authorizing the Federal Trade Commission to administer patents for Government employees has been eliminated.

The bill increases the salaries of the principal examiners in the Patent Office from $2,700 to $3,900 per year. Assistant examiners are allowed increases ranging from $150 to $900 per year. It is generally recognized that the salary of the principal examiners is the most important feature of the entire bill. Representative Lampert of Wisconsin, chairman of the committee, expresses the opinion that the salary of the principal examiners should be much higher than the $3,900 provided in the bill, but says the committee had agreed on that figure in the hope that it would not be questioned and the bill passed as an emergency measure. He calls attention to the fact that the American Patent Law Association after a referendum vote expressed the opinion that the principal examiners should receive $5,000. The National Research Council placed the salary at $4,200, but with the idea of naming a figure that would pass at a time when Congress is emphasizing the need of retrenchment. In the Lehlbach reclassification bill the salaries of these examiners are placed at $5,040.

The bill also increases the commissioner's salary from $5,000 to $6,000; that of the first assistant commissioner from $4,500 to $5,500; second assistant commissioner from $3,500 to $5,000; chief clerk from $3,000 to $4,000; one solicitor from $2,750 to $5,000; five law examiners from $2,750 to $4,000; two examiners of interferences from $2,700 to $5,000. Five members of the board of examiners-in-chief who are appointed by the President and who under the statute must have both scientific and legal training, will be allowed an increase by this bill from $3,500 to $5,000.

The demoralized condition of the Patent Office may be understood when it is known that there are now 46,472 applications awaiting attention. The number of pending applications is increasing all the time. In a little over a year 110 examiners—one-fourth of the total examining force—have resigned. These men were experienced examiners, with from two to twenty years training. Their places have been taken by young men just out of college—the only ones apparently to whom the salaries appeal. The difficulty is, Mr. Lampert points out, that they have no patent experience, and cannot act in intricate technical cases as rapidly as can those who have spent years in the Patent Office working with those subjects.

Critical Tables of Constants

The Board for Scientific Control of the project planned by the National Research Council for publication of critical tables of physical and chemical constants is now fully organized with the following membership:

R. B. Moore, of the Bureau of Mines; C. E. K. Mees, Eastman Kodak Co., and John Johnston, Yale University. Physicists, C. E. Mendenhall, University of Wisconsin; G. K. Burgess, Bureau of Standards, and Saul Dushman, General Electric Co., Schenectady. Dr. Dushman has been appointed to succeed Dr. P. W. Bridgeman, who was previously elected to membership on the committee.

It is hoped that a preliminary effort can be made on the physical constants work in the very near future, as the sums of money already subscribed insure that some effort can be undertaken at an early date. However, the sums available do not altogether provide for the project and additional subscriptions will be sought as soon as business conditions seem to justify this.

Industrial Alcohol Legislation

After hearing representatives of the American Chemical Society and of the manufacturers of industrial alcohol, the Committee on Rules of the House of Representatives reversed its attitude on the Volstead amendment and declined to give the Judiciary Committee the rule upon which it has insisted. This unexpected obstacle to the Judiciary Committee's program made it necessary to report out a bill by Representative Campbell which covers the amendments in which the manufacturers of industrial alcohol are not interested and leaves unchanged the provisions of existing law with regard to industrial alcohol. As this is written, there is some uncertainty as to the possible effect of a committee amendment which was added to the Campbell bill. This is the provision for re-enacting the penal sections of former internal revenue legislation. Manufacturers and consumers of industrial alcohol are particularly anxious that the troublesome statute which permitted the assessment of the beverage tax on all alcohol which does not enter absolutely into manufacture be not re-enacted. Under that law, the Bureau of Internal Revenue formerly assessed the beverage tax on alcohol lost through leakage, through destruction in railroad wrecks, and on that stolen or which failed to enter into manufacture for many other reasons. A careful examination of the statute now is being made to determine just what this will re-enact.

Encouragement of Scientific Research

Encouragement of scientific research in the fields of chemistry, metallurgy and engineering as well as in other scientific lines is accomplished in America by many funds, medals, prizes, etc. The National Research Council has made an extended investigation of the means used during 1920 for this encouragement of science and research. The following items which deal specifically with chemistry are taken from the Council's bulletin No. 9, just issued. There are shown the medals and prizes, the grants for research work, the institutional funds, and the fellowships and scholarships. These form a very imposing list of items.

Chemical Medals and Prizes

Awards of the Glass Container Association of America. Seven awards for theses submitted prior to June 10, 1921, to stimulate more general research along the lines of better preparation and packing of foods and beverages, and to increase our knowledge of changes induced by preparation or storage of such products. Established 1920. Annually available, \$50-\$150.

Gibbs Medal of the American Chemical Society, Chicago Section. For eminent work in and original contributions to pure or applied chemistry. Established 1911. Present fund, \$7,500.

Grasselli Medal of the Society of Chemical Industry. For thesis presented before the society and offering the most useful suggestions in applied chemistry.

Nichols Medal of the American Chemical Society, New York Section. For meritorious research in organic chemistry. Established 1902. Present fund \$1,700. Annually available, \$98.

Perkin Medal of the Society of Chemical Industry. For the most valuable work in applied chemistry. Established 1906.

Scott Medal Fund. Medal and premiums awarded from time to time for useful inventions that will advance chemical, medical or any other science, or promote the development of industry in any form. Established 1816. Original fund, about \$4,000. Present fund, about \$100,000. Annually available, \$4,000 or more.

Grants

Chittenden Fund of Yale University. For research in physiological chemistry. Established 1915. Original fund, \$4,000. Annually available, \$192.

Clark Fund of the Harriman Research Laboratory. Endowment Fund, for the promotion of research in medical and biological sciences. Established 1912. Annually available, \$25,000.

Gibbs Fund of the National Academy of Sciences. For research in chemistry. Established 1892. Original fund, \$2,600. Present fund, \$5,545. Annually available, \$308.

Research Fund of the American Medical Association, Council on Chemistry and Pharmacy. Fund of Committee on Therapeutic Research, used in connection with chemical investigations conducted by accredited research workers. Annually available, \$2,000.

Research Fund of the National Canners Association. Grants for chemical, bacteriological and technological research relating to the manufacture of canned goods, systematic study of food poisons as applied to canned foods but not limited to this phase and the study of botulism.

Warren Fund of the American Academy of Arts and Sciences. For research in chemistry. Established 1892. Original fund, \$6,000. Present fund, \$13,289. Annually available, \$1,254.

Institutional Funds

Anonymous Fund for Wolcott Gibbs Laboratory of Harvard University. For research in physical and inorganic chemistry in the Wolcott Gibbs Laboratory. Original fund, \$5,000. Present fund, \$5,055.48. Annually available, \$55.48.

Appropriation to Nutrition Laboratory of Carnegie Institution of Washington. Endowment, for the encouragement in the broadest and most liberal manner of investigation, research and discovery, and the application of knowledge to the benefit of mankind. Established 1902. Original fund, \$10,000,000. Present fund, \$22,120,000. Available for 1920, \$52,432.39.

Contract with Ordnance Division of War Department of Yale University. For experimental work on explosives. For 1920-21, \$10,000.

Dalton Fund of the Mass. Institute of Technology. For payment of fees for research in textile chemistry. Present fund, \$55,000. Annually available, \$250.

Division of Applied Chemistry Testing Work Fund of the University of Illinois. For research work in chemistry. Annually available, \$5,516.

Endowment Fund of the Harriman Research Laboratory. For the promotion of research in medical and biological sciences. Established 1912. Annually available, \$25,000.

Food Research Institute of Leland Stanford Junior University. For the intensive study of the problems of production, distribution and consumption of food. Established 1921. Present fund, \$700,000. (Provided by Carnegie Corporation for support of the Institute for ten years.)

McCurdy Research Fund of Case School of Applied Science. For the use of seniors in chemistry for research. Annually available, \$1,000.

Organic Chemistry Research Fund of Yale University. For research in this subject. Established 1918. Original fund, \$600.

Research Fund of American Institute of Drug Proving. For work on drugs. Original fund, \$3,250. Annually available, \$129.

Research Fund in Chemistry of the California Institute of Technology. For research in chemistry Established 1915. Present fund, \$200,000. Annually available, \$10,000.

Richards Fund of Mass. Institute of Technology. For research in chemistry. Present fund, \$15,000. Annually available, \$600.

U. S. Interdepartmental Social Hygiene Fund of Northwestern University. For research in chemistry department for compounds of therapeutic value in the treatment of venereal diseases. Established 1920. Present fund, \$5,000, for 1920-21 only.

Warren Fund of Harvard University. For the promotion of chemical research or the advancement of chemical science. Established 1893. Original fund, \$4,500. Present fund, \$7,595. Annually available, \$387.

Fellowships and Scholarships

Barnard Fellowship of the University of Chicago. For research in chemistry. Established 1915. Present fund, \$3,000. Annually available, \$156.

Bloede Scholarship of the Chemists Club of New York. For research in industrial chemistry and engineering. Established 1916. Original fund, \$10,000. Present fund, \$10,000. Annually available, \$500.

Carr Fellowship of the University of Illinois. For research in chemistry. Established 1919. Original fund, \$10,000. Present fund, \$10,000.

Chemistry Fellowship of University of Utah. For research in chemistry. Annually available, \$2,800.

Class of 1883 University Fellowships of Princeton University. For research in the department of politics, physics, chemistry, biology or geology. Established 1910. Original fund, \$30,000. Annually available, \$600 to each of two fellowships.

Columbia Univ. Fellowship of the University of Washington. For research in mining, engineering, and chemistry. Established 1917. Annually available, $250.

Emerson Scholarships of Harvard University. For research in zoölogy, geology, mineralogy and chemistry. Established 1903. Original fund, $20,656. Present fund, $37,761.17. Annually available, $400 each.

Fellowships of the California Institute of Technology. Six teaching fellowships in chemistry, for teaching, study and research in chemistry. Established 1917 and 1919. Annually available, $750 each; and three fellowships for physical and chemical research. Established 1916. Annually available, $1,000 each.

Fellowships of the National Research Council. For research in physics and chemistry. Supported by the Rockefeller Foundation. Established 1920. Present fund, $500,000. Annually available $100,000.

Grafflin Scholarships of Johns Hopkins University. For research in industrial chemistry. Established 1915. Annually available, $1,000.

Goldschmidt Fellowship of Columbia University. For research in chemistry. Established 1908. Present fund, $16,350. Annually available, $736.47 (1920-21).

Hart Fellowship of Lafayette College. For research work on problems connected with viscous and plastic flow. Restricted to students in chemistry holding bachelor's degree. Established 1910. Original fund, $10,000. Annually available, $500.

Harvard Fellowship in Chemistry of Princeton University. For research in chemistry. Established 1905. Original fund, $10,000. Annually available, $500.

Herter Research Fellowship of New York University For research in chemical pathology, physiological chemistry or pharmacology. Established 1903. Original fund, $6,000. Annually available, $300.

Home Economics Research Fellowship in Nutrition of the University of Chicago. For research in nutrition or related fields. Established 1919. Annually available, $600.

Hoskins Fellowship of the University of Chicago. For research in chemistry. Established 1919. Annually available, $400.

Huff Memorial Research Fellowship of Bryn Mawr College. For research in either physics or chemistry. Established 1913. Annually available, $1,200.

Hoffman Scholarship of the Chemists Club of New York. For research in industrial chemistry and engineering. Established 1916. Original fund, $10,000. Present fund, $10,000. Annually available, $500.

Loewenthal Fellowship of the University of Chicago. For research in chemistry. Established 1900. Present fund, $10,000. Annually available, $400.

Loomis Fellowship of Yale University. For research in physics. Established 1902. Original fund, $10,000. Annually available, $465.

Moore Scholarship of the Mass. Institute of Technology. For study of organic chemistry in Europe. Awarded from time to time. Annually available when awarded, $250.

Research Fellowship in Chemistry in Bryn Mawr College. Resident Research Fellowship, for research in chemistry. Established 1893. Annually available, $530.

Shevlin Fellowship of the University of Minnesota For research in agriculture, chemistry, medicine and one in any subject. Annually available, $500 each.

Swift Fellowships of the University of Chicago. For research in chemistry. Established 1908. Present fund, $17,809. Annually available, $920.

Teaching Fellowship of Leland Stanford Junior University. For research in chemistry (2). Established 1917. Annually available, $600 each.

Teaching Fellowship of the Calif. Institute of Technology. Six fellowships for teaching, study and research in chemistry. Established 1917 and 1919. Annually available, $750 each.

Traveling Fellowship of the American Scandinavian Foundation. Traveling Fellowships (20) of $1,000 each, five for travel and study in Denmark, ten in Sweden and five in Norway, for the purpose of drawing the American and Scandinavian peoples closer in bonds of intellectual kinship. Established 1911. Original fund, $500,000. Present fund, $565,082.48. Annually available, $40,000. (Only one-half available for United States.)

Upjohn Co-operative Fellowship of Yale University. For research in organic chemistry. Established 1919. Annually available, $700.

Wisconsin Gas Association Fellowship of Univ. of Wisconsin. For research in chemical engineering. Annually available, $500.

Woodward Fellowship of the University of Pennsylvania. For research in physiological chemistry.

Tests of Brazed Copper Sheets Intended for Roofing Purposes

Recently the Library of Congress submitted to the Bureau of Standards for test some copper sheets for roofing purposes which had been joined by brazing. Two types of joints were used, a simple "lap" joint and a "lock" joint in which the edges of the two sheets to be joined were first bent double and then "locked" into each other.

The series of examinations indicated that of the two types of joints designated as lap and lock, the lap joint is superior in strength and much more desirable in its structure. In forming the lock joint apparently it is necessary to apply the heating torch for a considerably longer period in order to cause the metal to flow into the joint. In doing this the upper fold of the sheet which forms the lock is highly heated and often burned. It was noticed in most cases that none of the brazing metal penetrated directly below the upper fold, so that the upper sheet could easily be bent along the line of the junction. It appears from the results of this examination that if the buckling of the sheets, which apparently cannot be entirely prevented with this method of joining sheets, is not too objectionable, the lap joint should be satisfactory for the purpose. The lock joint is decidedly inferior in strength and other properties to the lap joint.

It may be pointed out that the joints should be carefully cleaned after brazing. In the specimens submitted, the film of zinc chloride remaining after cleaning the specimens was sufficient to accelerate atmospheric corrosion very decidedly within a very short time.

$250,000 Appropriated for Helium Studies

The army appropriation bill, as finally approved by the conferees on the part of the Senate and the House, carries $250,000 for "experimentation, conservation and production of helium." This is a very material cut from the $800,000 requested by the War Department.

The bill gives authority "to explore for, procure or reserve helium gas" and also provides for "the purchase, manufacture, construction, maintenance and operation of plants for the production of helium and experimentation therewith."

Book Reviews

METALLOGRAPHY, Part II, The Metals and Common Alloys. By *S. L. Hoyt.* New York: McGraw-Hill Book Co., Inc., 1921. Price, $5. 462 pages, illustrated.

This is a continuation of the author's text and reference book on Metallography and "describes the more important metals and alloys," including chapters on Pure Metals, White Metal Alloys, Light Metal Alloys, Brasses and Bronzes, Steel and Cast Iron and Special Steels.

We have had in the past reference books dealing with the properties of alloys without much reference to their structure and constitution as well as those dealing with the structural, thermodynamic equilibrium of alloys with but little description of their properties. This is, as far as the reviewer knows, the first one that deals adequately with both phases of this subject, so intimately related, and discuses theoretical as well as practical aspects of metals and alloys. As a typical example of the mode of treatment, the chapter on light aluminum alloys discusses the structure of light alloys with the usual diagrams and typical photomicrographs, interprets by their aid the effect of different alloying elements and impurities on the properties of the alloys, and describes the useful properties of commercial alloys, giving tables of their numerical magnitude.

The material is, in general, quite up to date. The large

number of references proves a very thorough bibliographic mastery of the subject on the author's part and is of the greatest value to the reader.

It is to be hoped that in a second edition those paragraphs in description of commercial alloys available in this country will be much expanded, particularly with respect to the brasses and bronzes. Perhaps manganese bronze should be treated under the caption of brasses instead of that of bronzes if correct nomenclature is to be followed. It is possibly a personal prejudice that leads the reviewer to regret the absence of any discussion of several important alloys of nickel, such as nickel-silver, copper-nickel, nickel-chromium, and Monel metal.

The chapters on iron, steel and alloy steel are quite full; in particular there are very good paragraphs on the inclusions in steel. Adequate tables are given of the mechanical properties of the alloy, or automobile steels; it is believed, however, that these chapters would be improved by the addition of some representative photomicrographs of commercially heat-treated nickel and chromium-nickel steels of good quality. Text-books evince a disposition to reproduce structures of pathologic specimens of heat-treated steel only, which may perhaps be somewhat misleading to the student without practical experience.

In brief, this volume appears to invite frequent consultation both by experienced and inexperienced in this field and to excite the hope that the third part of this series, on Technical Practice, will soon appear. PAUL D. MERICA.

* * *

THE RECOVERY OF NITRATE FROM CHILEAN CALICHE. By *Arthur W. Allen.* 50 pages. London: Charles Griffin & Co.

Many engineers and chemists have spent years in the caliche fields of Chile and have come away without more than a descriptive outline of the processes used in the nitrate industry. Mr. Allen proves to be an exception, has had ideas on how its technology can be improved and has incorporated them into a little text that should prove to be an accelerator in speeding up the adoption of better methods. He describes the Shanks process both in the extraction and crystallization stages as now practiced. He then takes up the question whether an alternative scheme is desirable. In conclusion he lays out his own plan using upward percolation and thus reducing the frictional resistance of the slimy borra earths. Improvements in evaporation and the use of the salt grainer are amply discussed. As no adequate laboratory facilities and services were available, the chemistry of the solution of mixed salts was not taken up in the author's investigation.

WALLACE SAVAGE.

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THE MICROSCOPE: ITS DESIGN, CONSTRUCTION AND APPLICATIONS. A symposium and general discussion published in the *Transactions* of the Faraday Society, London. 260 pp. 1920. Price 15s.

The recent and rapid development of microscopes and the great interest shown in microscopic methods of research and testing are reflected in this series of articles covering the following subjects:

Introductory Address by Sir Robert Hadfield; General Papers on the Mechanical Design of Microscopes and the History and Design of Photomicrographic Apparatus; The Optics of the Microscope, Including Notes on the Resolving Power of the Microscope; The Manufacture of the Microscope; Aspects of Microscope Design and Construction; Optical Glass; Applications of the Microscope, Including Applications in Metallography, Metallurgy and Engineering and Applications to Metrology; Testing of the Microscope; Notes on Light Filters; Description of the Davon Micro-Telescope and Super-Microscope.

Sir Robert Hadfield, always an interesting writer, presents a fascinating history of the microscope from ancient times to the present which includes photographs of Dr. Sorby, Dr. Dallinger, Dr. Zacharias Iansen, Hans Lipperhey and Leeuwenhoek, a reproduction of the front page of Robert Hooke's Micrographia published in 1665 and a complete bibliography of the chief literature relating to micrography from 1665 to 1919 inclusive.

A description of these *Transactions* in detail would require a volume in itself; therefore I must content myself with a few remarks on that portion of the book most interesting to chemists and metallurgists.

Sir Robert Hadfield contributes some unusual notes on the "Great Work of Sorby" and publishes some of Sorby's early photomicrographs of hammered bloom and blister steel, magnified nine diameters. By way of contrast he also shows some photomicrographs of pearlite magnified from 5,000 to 8,000 diameters. In this connection the writer would like to remark that apparently nothing is gained by an increase above 1,500 diameters, the effect at the extremely high magnification being the same as that produced on a lantern screen by enlargement of a negative taken at 1,500 diameters. In fact in one case an enlargement to approximately 5,000 diameters from a photograph taken at 1,500 diameters of pearlite and graphite in cast iron looks fully as clear if not slightly clearer than a photomicrograph taken from the identical spot and magnified 5,000 diameters. Some of these high-powered photomicrographs, however, are reproduced in plates 5¼ x 7½ in. and produce a rather striking effect.

The well-known names of LeChatelier, Sauveur, Benedicks, Rosenhain, Desch, Giolitti and E. F. Law are found in connection with brief articles on Improvements in Metallurgical Microscopes.

Benedicks comes to the following conclusions after a detailed and critical examination of the new Reichert microscope (of the LeChatelier type):

(1) An arc lamp (350 c.p.) or an incandescent lamp (50 c.p.) gave exactly the same result.

(2) A modification of the microscope is proposed to diminish sensitivity to vibration.

(3) The proper arrangement of the diaphragms is discussed.

(4) A LeChatelier prism and a 45 deg. prism give at high magnification exactly the same result.

(5) A metal mirror gives slightly better contrasts than a prism.

(6) In the plain glass illuminator a thickness of 0.45 mm. does not injure sensibly the image quality.

(7) A slightly platinized glass illuminator gave somewhat finer details than any other illuminator used; this question, however, needs further research.

Dr. Zay Jeffries contributes some notes on the measurement of grain size.

Some references are found to the new Pointolite lamp, which consists of a small tungsten arc, and would seem to give promise of good results in photomicrography. It would add to the value of this book if a more complete description of this lamp had been included.[1]

The book is commended as a very valuable reference book for its detailed information to all metallurgists using the microscope as a method of testing and research and to all other users of the microscope. It serves as an excellent review of the history of this instrument and its recent developments, and should be in the hands of every one interested in science, whether pure or applied.

H. M. BOYLSTON.

Personal

CHARLES COPELAND, assistant treasurer of E. I. du Pont de Nemours & Co., has been elected a member of the board of directors and secretary of the company to fill the vacancies caused by the death of Alexis I. du Pont. Mr. Copeland has been assistant treasurer of the company for eighteen years.

Mme. CURIE and IRVING LANGMUIR received honorary degrees of Doctor of Science at Northwestern University, Evanston, Ill., June 15.

OTTO EISENSCHIML, president of the Scientific Oil Compounding Co. of Chicago, sailed the latter part of June for

[1] "A New Microscope Illumination," see CHEM. & MET. ENG., vol. 20, p. 281 (Feb. 11, 1920).

a trip through Europe. Among other points he will visit will be Vienna, Austria.

ISMAR GINSBERG announces the opening of an office in the Chemists' Club Building, with all facilities for undertaking investigations into the literature, patent searches and regular service on selected topics. He will also compile bibliographies and furnish translations from all foreign languages.

THOMAS F. RILEY, manager of the Imperial Porcelain Works, Trenton, N. J., has been appointed by Gov. Edwards a member of the board of directors of the Trenton School of Industrial Arts, to succeed the late Karl G. Roebling.

Prof. ROBERT F. RUTTAN, of McGill University, Montreal, Canada, has been nominated president of the Society of Chemical Industry for next year, succeeding Sir William Pope.

MAX Y. SEATON, who was chemical engineer with the Dow Chemical Co., Midland, Mich., particularly in charge of the oxychloride research division, is now technical director of the National Kellastone Co. of Chicago. He is also in charge of technical work for the Sierra Magnesite Corporation of Porterville, Cal.

WILLIAM O. THOMPSON has resigned as chairman of the board of directors, American Cotton Oil Co., New York, effective July 1.

FRED A. WHITAKER, superintendent of the Keasbey, N. J., plant of the General Ceramics Co., New York, will sail for Europe at an early date for a two months' pleasure trip abroad with Mrs. Whitaker. England, Germany and other countries will be visited.

GERALD L. WENDT has been promoted from assistant to associate professor at the University of Chicago.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, June 27, 1921.

Irregular periods of inquiry, followed by intervals of dullness, featured the chemical market during the past week. The inquiries involved both domestic and export requirements, but buyers' and sellers' views differed on export account sufficiently in most instances to restrict any actual transactions. Italy, South America and Canada seemed to be foremost on the list of foreign buyers. Domestic consumers did not depart appreciably from their conservative attitude and showed a preference for only small lots. The market in general is behaving well under serious declines in outside commodities and securities and in the face of a cross-current of trade reports emanating from various sources. A peculiarity is that all recent advances were well sustained and there were several instances where an actual shortage of spot supplies existed.

Among the large items caustic soda and soda ash are still showing the most strength in the open market. Both chemicals have continued in scant supply on the spot and small-lot buyers often had the price advanced by sellers. This continued small-lot buying has seemed to have its effect on supplies. Producers received most of the call for carlots and it is understood that a fair volume of business was placed at the works. Italy has sent numerous inquiries for soda ash at prices a trifle below the domestic market. It was stated among leading soda ash manufacturers that foreign producers nearer Italy are naming figures which prevent any active competition on the part of American producers. Regarding the surplus supplies of caustic soda in South America, it is stated that stocks are steadily decreasing and that business in caustic will probably show some real improvement in the very near future. Nitrite of soda showed a stronger tone late in the week under an improved inquiry and a tightening of holdings. This chemical requires a license to import and should naturally recover very easily on any display of buying power. Bichromate of soda ruled fairly steady on the spot market. The call for small lots was quite active and this with relatively low supplies in second hands had a strengthening market influence. Bleaching powder sold fairly freely at the works. Large dealers are competing for prospective business and considerable trading went through at prices ranging from \$2.10@\$2.20 per 100 lb. at the works. Salt cake showed signs of becoming more active, and it looked as though some buyers both home and abroad were feeling out the market prior to replenishing their stocks. Camphor advanced sharply under an improved demand and strong foreign cables.

MARKET DEPENDS ON FOREIGN POLICIES

While confidence is increasing, the immediate outlook is uncertain regarding business. There are enough conflicting influences at present to create a cautious feeling among buyers and little material improvement can be expected until our foreign policies are more clearly defined and the tariff tangle is straightened out. The following is a report recently made public by the American Section of the International Chamber:

"The United States is one of the chief sufferers from the partial dislocation of the trade of the world and unless she is prepared to extend credits on a large scale she must look forward to a great decrease of her export trade which will react unfavorably upon industrial conditions and retard her recovery from the present depression. The problem of the readjustment of foreign trade relations is one of the most important developments that has resulted from the world war and upon her success in solving it the commercial prosperity of the United States during the next few years will in no small degree depend."

Labor conditions are improving and the possibility of lower freight rates seems nearer. Exchange has shown a disposition to recover and money rates have worked to a lower loaning basis. These are at least favorable factors, but a revival of export trade is what the chemical market wants.

CHEMICALS

New arrivals of German *caustic potash* are having a disposition to check any advancing tendency which this chemical might display. The general quotation for this material is 5¼@5½c. per lb. for the 88-92 per cent. Sales, however, have gone through below the inside figure and the market in some quarters is irregular owing to the keen state of competition existing. Yellow *prussiate of potash* is moving quietly on the basis of 24½c. per lb. ex-store. Sellers quote 24½@26c. per lb. The red variety is quiet, with small lots obtainable at 35c. per lb. It is very probable that on a firm offer this figure could be shaded. Sellers of *citric acid* generally quote 46@47c. per lb. for spot material, but odd lots are obtainable below these prices and in one quarter 45c. is heard. The quiet extent of the inquiry at present has left the market somewhat irregular, although supplies do not seem to be heavy and it looks as though the market is in a position to respond to any real improvement in demand. Odd lots of imported *oxalic acid* are offered on the spot at 18c. per lb. Most sellers are maintaining prices at 19c. and upward, depending upon the brand and quantity.

Small-lot trading continues to feature the market. Resale *bichromate of soda*, standard make, was somewhat irregular during the latter part of the week, with dealers quoting 8@8½c. per lb. on spot, and rumors of odd-lot sales a shade under the inside figure. Demand was not active and scarcely enough business passed to really test values. Offerings were not heavy and some interests express the opinion that relatively little stock could be purchased around prevailing quotations. No important change in spot prices for resale lots of standard brands of solid *caustic soda* could be noted. Prominent dealers stated that \$4.10 per 100 lb. could be done on limited quantities, while most sellers quoted the market at \$4.15@\$4.25 ex-store according to size of order. The contract price is steady at 3¼c. per lb., basis 60 per cent, f.o.b. works. Domestic *cyanide of soda* is quoted at 29c. per lb. asked, while the French and German grades are quoted at 19½ and 20c. per lb. respectively. The market is irregular with competition keen for new business. It is possible that domestic producers will shade

the above price when there is sufficient business to warrant it. Spot *nitrite of soda* was quoted at 7½@8c. per lb. by dealers with trading rather quiet. Some odd lots could probably be purchased at concessions, but the bulk of supplies appears to be well held at present. Small-lot inquiries are reaching the market occasionally, but there is no permanent buying movement in progress at the moment. The inquiry for light *soda ash* is holding up now and prominent dealers state that sales of single bags are going through at $2.15@$2.20 per 100 lb. ex-store and that a good movement of small lots in barrels is in progress at $2.60@$2.70 per 100 lb. Dealers quote at the works $1.60 per 100 lb., basis 48 per cent, in single bags and $1.95, basis 48 per cent, in barrels. Leading producers reported a fairly good call for *bleaching powder* at the works and stated that sales went through in moderate volume at $2.10@$2.20 per 100 lb. in large drums and up to 2½c. per lb. in small drum containers. Moderate trading on spot was reported at 2¼@2¾c. per lb. Trading in the technical variety of *epsom salts* was reported at $1.20 per 100 lb., while considerable business in the U.S.P. grade went through at 2¾c. per lb. The above prices were named by prominent sellers at the close.

Coal-Tar Products

The tone of the coal-tar products market during the past week has been steady, but there has been no tendency shown to operate on other than a routine small-lot basis. A wider range of trading is developing and some of the more stagnant materials are beginning to move into consuming channels. While the summer period will be attended with the usual quiet trading, the outlook is healthy and no setbacks are expected. Prices are holding well and few distressed lots are glaring among the offerings. *Benzene* is in heavy demand and with production curtailed the available supply is said to be shy and prices are firm. *Cresylic acid* is in easy supply and prices depend on seller. *Naphthalene* is in very light demand and while resale lots range around 7@7½c. per lb. producers seem to be holding at the former level of 8½@9½c. for the prime white flakes. Quite a number of foreign inquiries have reached the market for *phenol*, but no sales have resulted as yet. Orders for intermediates in small quantities have been fairly well distributed and a few inquiries for round lots are reported. There seems to be a scarcity of *para-nitrophenol*, and orders for spot goods are not available. The market for *beta-naphthol* is reported firm at 38@42c. per lb. Supplies of *aniline oil* are reported easy at 20@26c. per lb. *Dimethylaniline* is steady at 40@50c. per lb., depending on quantity and seller. The inquiry for *benzoate of soda* is showing seasonable improvement and in some directions a decidedly better run in business was reported. It is stated that a fair volume of sales has been made for shipment to canneries on the Pacific Coast, and it is expected that demand from the East will increase with the advance of the season. Prices range from 55@60c. per lb., according to quantity and seller. The market is quoted firm at the inside figure. The output of *para-dichlorbenzene* is confined to few makers and at the moment available supplies are scarce. The consuming demand, however, is not very active and prices are quotably unchanged at 15@25c. per lb., depending on quantity. The demand for supplies of *para-phenylenediamine* has fallen away lately, but the tone is steady and prices range from $1.75@$2 per lb. The consuming demand for *nitro-benzene* still holds to a dull routine nature for small quantities, while supplies are easy and quoted at 12@15c. per lb. The demand for supplies of *meta-phenylenediamine* continued in fair volume during the period and sales were on the basis of $1.15@$1.20 per lb.

The St. Louis Market

St. Louis, Mo., June 24, 1921.

The fine chemical market continued to expand the last week, with inquiries more frequent and for larger quantities. In spite of the slumping off in demand the past two weeks for heavy chemicals in general, prices for the most part remain unchanged. This would indicate that the second-hands' stocks are about depleted and that the present quotations are again based upon the actual manufacturers' cost. The drug market underwent little change during the last week and the present prices quoted could be safely taken as a level at which buyers could operate and feel assured that no further reductions would take place.

Alkalis

Caustic soda continues to move in small lots even to the formerly large buyers, with no contracting being done. Price, the same. *Soda ash* is still quoted at $2.90@$3 per 100 lb., basis 58 per cent, with demand slightly under routine. *Sal soda* is in routine demand, price $1.90@$2.50 per 100 lb according to the quantity ordered. *Bicarbonate of soda* is inactive.

Industrial Chemicals

There has been a heavy demand for *ammonia water*, 26 deg., with the market firm. *Carbon bisulphide* has shown some improvement since our last report. A heavy demand for *iron sulphate crystals* has been evident lately. The outdoors season is showing very good effects on the *hyposulphite of soda* demand, which continues to increase. *Sulphur* holds very firm at 2¼c. for the commercial in bags, with a good demand.

Drugs and Pharmaceuticals

Citrates continue to command a fair volume of business. An excellent demand for both *soda* and *potassium bromide* has been experienced since our last report, with the market firm in spite of the heavy importations. *Cream of tartar* continues in a fair way. *Glycerine* again declined and is now quoted at 16c. per lb. for both spot and contract. Shading to 15¾c. per lb. on *glycerine* is not uncommon. The majority of contracts for the next six months have been signed. A very brisk demand for *hydrogen peroxide* is now coming from all sources and some fair sized business has passed in the last ten days. An improved demand for *iodides* has been experienced since our last report, especially the *potash salt*, which undoubtedly is due to the resale stocks having been practically absorbed. *Mercurials* have shown a lack of interest in spite of the reduction made a couple of weeks ago. *Salicylates* continue to enjoy a fair demand and business in a routine way is being done.

Acids

There has been no change in the conditions of *carbolic acid crystals* since the last report. The demand for *citric acid* fails to show any improvement and new features of interest are still lacking. Apparently beverage manufacturers continue to pursue their conservative policy in buying. The revival of activity in aniline dye manufacture has led to an improvement in the demand for *gallic acid* and a very nice business is now being transacted in this commodity. Factors report that the demand for *hydrochloric, nitric* and *sulphuric acid*, commercial grades, is remarkably good despite the increase in price recently made by the manufacturers. *Phosphoric acid sirupy* fails to show any improvement. A heavy demand for *acid pyrogallic* both *resublimed* and *crystals* is coming from the photographic trade.

Vegetable Oils

Linseed oil reached a peak of 82c., basis raw in cooperage, from warehouse, and today holds at 79c. per gal. for spot and forward to Aug. 1, though practically no contracting is being done. *Castor oil* continues to hold at 10½c. per lb. in drums, with fair demand. The *turpentine* demand is under routine with price uniform at 65c. in 5-bbl. lots.

The Iron and Steel Market

Pittsburgh, June 24, 1921.

From an already light demand for steel products there has been a further decrease, one that can hardly be explained on the ground of further decrease in consumption, and is probably attributable to manufacturing consumers making a still more strenuous effort to dispose of such stocks as they have had on hand. Manufacturing consumers who normally carry thousands of tons of rolled steel are now unwilling to carry hundreds of tons and if they cannot use the steel themselves they sell it for what it will bring. The most drastic liquidation in the history of the steel industry in stocks of steel is in progress, and is now nearly completed. The liquidation would be easier were

not manufacturing consumption so light. The direct bar to manufacturing activity is large stocks of manufactured goods, agricultural implements, machinery, hardware, cutlery, tools and the like. These manufactured goods will be liquidated in time, but the process is slow.

No "Consumption" of Steel

Meanwhile the country's general activity has not slowed down by anything like the percentages that are shown by steel production. The freight ton mileage on the railroads in March was 63 per cent of the rate in the record month in all history—August, 1920—while it was approximately equal to the average rate in the best year before the war. The trade now has to make a distinction between the "consumption" of steel and the "use" of steel. Before the war it was held, and the point was supported by all experience, that the production of steel could not go below about 50 per cent of capacity, because the country always had to have a considerable quantity of steel even in bad times. The country is employing or using steel fairly well even at the present time, but it is not putting much more into use—it is not "consuming" steel in that sense.

Steel Production

The production of steel is now at about 22 or 23 per cent of capacity, against an average rate of 80 per cent in the first nine months of last year, and the rate may get down to 15 per cent or even 10 per cent in July. As liquidation in stocks of steel and, still more important, in stocks of wares made from steel, progresses there will be increased demand upon the steel mills, probably in August, quite certainly in September. If July shows a 15 per cent production of steel and September a 30 per cent production there will be a 100 per cent gain, and the steel industry will still be operating at a rate inconceivably low from the viewpoint of all times before the war. The demand is going to increase slowly, beginning in August or September. At no time in the discernible future will there be a rush for steel, since the mills have shown wonderful ability to fill orders within a very few days of their receipt and occasion will not arise in the near future for anyone to build up stocks of steel or of goods made from steel.

Steel Prices

Steel prices are sagging, yielding on the slightest provocation of inquiry that is at all tempting. Three weeks ago the Steel Corporation reduced prices on wire products $5 a ton, following selling by independents for some time at cut prices. A week ago today the Republic Iron & Steel Co. reduced its prices on sheets $5 a ton, on account of cutting by several other interests, three other sellers immediately following Republic, while last Tuesday the Steel Corporation met the reduction. The reductions are from the so-called "April prices." Bars are being shaded at least $2 a ton and plates and shapes $4, but no formal reductions in these lines have thus far been announced. Prices made just now are not regarded as a criterion for the future, when, with enough buying to make a real market, prices are going to be made that will yield with great difficulty if at all. A sound schedule of prices cannot be developed now, as there is not sufficient business going to make such a market.

Pig Iron and Coke

Pig iron prices are off about 50c. in the week, the market being now quotable at $22.50 for bessemer, $20.50 for basic and $21.50 for foundry, f.o.b. valley furnaces, with $1.96 freight to Pittsburgh.

Connellsville furnace coke has eased off and has sold at $3 per net ton at ovens, with extremely light demand.

A few sales of Lake Superior ore have established prices for the 1921 season, at $1 reduction from the 1920 schedule, thus restoring the 1919 prices, Mesabi non-bessemer being $5.55 per gross ton at Lake Erie dock. The reduction corresponds with the amount many furnace companies wrote off their ore inventories at the close of last year. The pig iron market some time ago reflected the decline in ore. The pig iron market is made by sales from furnace stocks, there being scarcely any production of furnace iron, and prices are in relation to prospective replacement cost, not the cost of the iron that is being sold.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	..... -	$0.40 - $0.45
Acetone	lb.	$0.12½ - $0.12¾	.13 - .13½
Acid, acetic, 28 per cent	100 lbs.	2.50 - 2.75	3.00 - 3.25
Acetic, 56 per cent	100 lbs.	4.00 - 4.25	4.50 - 5.50
Acetic, glacial, 99½ per cent, carboys	100 lbs.	9.75 - 10.00	10.25 - 10.50
Boric, crystals	lb.	.13½ - .14	.14½ - .15
Boric, powder	lb.	.15 - .15½	.16 - .16½
Citric	lb.	..... -	.46 - .47
Hydrochloric	100 lb.	1.50 - 1.65	1.75 - 2.00
Hydrofluoric, 52 per cent	lb.	.12¼ - .12½	.12½ - .13
Lactic, 44 per cent tech	lb.	.10 - .11	.11½ - .12
Lactic, 22 per cent tech	lb.	.04½ - .05½	.06 - .07
Molybdic, C. P.	lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric)		..... -	..... - .....
Nitric, 40 deg	lb.	.06½ - .06¾	.07 - .07½
Nitric, 42 deg	lb.	.07¼ - .07½	.07½ - .08½
Oxalic, crystals	lb.	.18 - .18½	.19 - .20
Phosphoric, 50 per cent solution	lb.	.13½ - .14	.14½ - .18
Picric	lb.	.20 - .25	.27 - .35
Pyrogallic, resublimed	lb.	..... -	1.90 - 2.15
Sulphuric, 60 deg., tank cars	ton	..... -	11.50 - 13.00
Sulphuric, 60 deg., drums	ton	..... -	13.00 - 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 - 20.00	..... - .....
Sulphuric, 66 deg., drums	ton	22.00 - 22.50	23.00 - 23.50
Sulphuric, 66 deg., carboys	ton	..... -	..... - .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	22.00 - 23.00	..... - .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	25.00 - 26.00	26.50 - 27.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.	..... -	.90 - 1.00
Tannic (tech.)	lb.	.50 - .52	.54 - .57
Tartaric, crystals	lb.	..... -	.30 - .32
Tungstic, per lb. of WO	lb.	..... -	1.30 - 1.40
Alcohol, Ethyl	gal.	..... -	4.80 - 5.00
Alcohol, Methyl (see methanol)		..... -	..... - .....
Alcohol, denatured, 188 proof	gal.	..... -	.31 - .36
Alcohol, denatured, 190 proof	gal.	..... -	.38 - .42
Alum, ammonia lump	lb.	.03½ - .03¾	.04 - .04½
Alum, potash lump	lb.	.03¾ - .04	.04 - .04½
Alum, chrome lump	lb.	.13 - .13½	.14 - .14½
Aluminum sulphate, commercial	lb.	.01¾ - .02	.02 - .02½
Aluminum sulphate, iron free	lb.	.03 - .03¼	.03½ - .04
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½ - .07¾	.08 - .08½
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 - .32	.33 - .35
Ammonium carbonate, powder	lb.	.08 - .08½	.09 - .10
Ammonium chloride, granular (white salamoniac)	lb.	.06½ - .06¾	.07 - .07½
Ammonium chloride, granular (gray salammoniac)	lb.	.07½ - .08	.08 - .08½
Ammonium nitrate	lb.	.07½ - .07¾	.08 - .08½
Ammonium sulphate	100 lb.	2.60 - 2.75	2.80 - 3.00
Amylacetate	gal.	..... -	4.00 - 4.25
Amylacetate tech	gal.	..... -	2.50 - 3.00
Arsenic oxide, (white arsenic) powdered	lb.	.06½ - .07	.07½ - .08
Arsenic, sulphide, powdered (red arsenic)	lb.	.11 - .11½	.12 - .13
Barium chloride	ton	59.00 - 59.50	60.00 - 62.00
Barium dioxide (peroxide)	lb.	.19 - .20	.21 - .22
Barium nitrate	lb.	.08½ - .09	.09½ - .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ - .05	.05½ - .06
Bleaching powder (see calc. hypochlorite)		..... -	..... - .....
Blue vitriol (see copper sulphate)		..... -	..... - .....
Borax (see sodium borate)		..... -	..... - .....
Brimstone (see sulphur, roll)		..... -	..... - .....
Bromine	lb.	.41 - .42	.43 - .45
Calcium acetate	100 lbs.	2.00 - 2.05	..... - .....
Calcium carbide	lb.	.04½ - .04¾	.05 - .05½
Calcium chloride, fused, lump	ton	24.00 - 25.00	26.00 - 27.00
Calcium chloride, granulated	lb.	.01¾ - .02	.02¼ - .02½
Calcium hypochlorite (bleach'g powder)	100 lb.	2.15 - 2.25	2.35 - 2.50
Calcium peroxide	lb.	..... -	1.40 - 1.50
Calcium phosphate, tribasic	lb.	..... -	.15 - .16
Camphor	lb.	..... -	.75 - .78
Carbon bisulphide	lb.	.06½ - .07	.07½ - .08
Carbon tetrachloride, drums	lb.	.10½ - .10¾	.11 - .12
Carbonyl chloride (phosgene)	lb.	..... -	.75 - 1.00
Caustic potash (see potassium hydroxide)		..... -	..... - .....
Caustic soda (see sodium hydroxide)		..... -	..... - .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.08 - .09	.09½ - .10
Chloroform	lb.	..... -	.42 - .44
Cobalt oxide	lb.	..... -	3.00 - 3.10
Copperas (see iron sulphate)		..... -	..... - .....
Copper carbonate, green precipitate	lb.	.20 - .21	.22 - .23
Copper cyanide	lb.	..... -	.50 - .62
Copper sulphate, crystals	lb.	.05¾ - .06	.06½ - .06¾
Cream of tartar (see potassium bitartrate)		..... -	..... - .....
Epsom salt (see magnesium sulphate)		..... -	..... - .....
Ethyl Acetate Com. 85%	gal.	..... -	.85 - 1.00
Ethyl Acetate pure (acetic ether 98% to 100%)	lb.	..... -	.50 - .52
Formaldehyde, 40 per cent	lb.	.13½ - .14	.14½ - .15
Fusel oil, ref.	gal.	..... -	3.00 - 3.25
Fusel oil, crude	gal.	..... -	1.75 - 2.00
Glauber's salt (see sodium sulphate)		..... -	..... - .....
Glycerine, C. P. drums extra	lb.	..... -	.16 - .16½
Iodine, resublimed	lb.	..... -	3.65 - 3.75
Iron oxide, red	lb.	..... -	.10 - .20
Iron sulphate (copperas)	ton	19.00 - 20.00	21.00 - 22.00
Lead acetate,	lb.	..... -	.11½ - .13½
Lead arsenate, paste	lb.	.09 - .09½	.10 - .11
Lead nitrate	lb.	..... -	.15 - .20
Litharge	lb.	.08½ - .08¾	.08¾ - .09
Lithium carbonate	lb.	..... -	1.30 - 1.40
Magnesium carbonate, technical	lb.	.09 - .09½	.10 - .11
Magnesium sulphate, U. S. P.	100 lb.	2.40 - 2.75	..... - .....
Magnesium sulphate, technical	100 lb.	..... -	1.20 - 1.75
Methanol, 95%	gal.	..... -	.78 - .80
Methanol, 97%	gal.	..... -	.80 - .85
Nickel salt, double	lb.	..... -	.14 - .14½
Nickel salt, single	lb.	..... -	.15 - .15½
Phosgene (see carbonyl chloride)		..... -	..... - .....
Phosphorus, red	lb.	.45 - .46	.47 - .50
Phosphorus, yellow	lb.	..... -	.35 - .37
Potassium bichromate	lb.	.11½ - .12	.12½ - .12¾

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$ .... - $	$0.30 - $0.31
Potassium bromide, granular	lb.	.... -	.16 - .25
Potassium carbonate, U. S. P.	lb.	.35 - .40	.45 - .50
Potassium carbonate, 80-85%	lb.	.05 - .05½	.06 - .07
Potassium chlorate, crystals	lb.	.08½ - .10	.10½ - .14
Porassium cyanide	lb.	.... -	.26 - .28
Potassium hydroxide (caustic potash)	lb.	.05 - .05½	.05¾ - .07
Potassium muriate, 80% K.C.L.	ton	49.00 - 50.00	.... - ....
Potassium iodide	lb.	.... -	2.75 - 3.00
Potassium nitrate	lb.	.09¼ - .09½	.10 - .12¾
Potassium permanganate	lb.	.31 - .32	.33 - .34
Potassium prussiate, red	lb.	.35 - .37	.38 - .40
Potassium prussiate, yellow	lb.	.24½ - .25	.25½ - .26
Potassium sulphate (powdered)	per unit	.... -	1.50 - 1.75
Rochelle salts (see sodium potas. tartrate)		.... -	.... - ....
Salammoniac (see ammonium chloride)		.... -	.... - ....
Sal soda (see sodium carbonate)		.... -	.... - ....
Salt cake	ton	.... -	30.00 - 32.00
Silver cyanide	oz.	.... -	1.35 - 1.38
Silver nitrate	oz.	.... -	.40 - .41
Soda ash, light	100 lb.	2.15 - 2.20	2.30 - 2.70
Soda ash, dense	100 lb.	2.40 - 2.45	2.50 - 2.75
Sodium acetate	lb.	.04¼ - .04½	.04¾ - .05¼
Sodium bicarbonate	100 lb.	2.25 - 2.40	2.50 - 2.75
Sodium bichromate	lb.	.08 - .08½	.08¾ - .09½
Sodium bisulphate (nitre cake)	ton	5.00 - 5.25	5.50 - 6.50
Sodium bisulphite powdered, U.S.P.	lb.	.05 - .05¼	.05½ - .06
Sodium borate (borax)	lb.	.06½ - .06¾	.07 - .07¼
Sodium carbonate (sal soda)	100 lb.	1.90 - 2.00	2.10 - 2.40
Sodium chlorate	lb.	.07½ - .07¾	.08 - .08½
Sodium cyanide	lb.	.19½ - .21	.22 - .30
Sodium fluoride	lb.	.11½ - .12	.12 - .13½
Sodium hydroxide (caustic soda)	100 lb.	4.15 - 4.25	4.30 - 4.80
Sodium hyposulphite		.... -	.03½ - .03¾
Sodium nitrate	100 lb.	2.90 -	3.00 - ....
Sodium nitrite	lb.	.07½ - .07¾	.08 - .09
Sodium peroxide, powdered	lb.	.25 - .26	.27 - .30
Sodium phosphate, dibasic	lb.	.04½ - .04¾	.05 - .05½
Sodium potassium tartrate (Rochelle salts)	lb.	.... -	.26 - .27
Sodium prussiate, yellow	lb.	.12¼ - .12½	.12¾ - .13½
Sodium silicate, solution (40 deg.)	lb.	1.25 - 1.35	1.40 - 1.50
Sodium silicate, solution (60 deg.)	lb.	.02¾ - .03	.03¼ - .03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.50 - 1.75	2.00 - 2.25
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.05½ - .05¾	.06 - .06½
Sodium sulphite, crystals	lb.	.03½ - .04	.04¼ - .04½
Strontium nitrate, powdered	lb.	.15 - .15½	.16 - .17
Sulphur chloride, red	lb.	.07 - .07½	.07½ - .08
Sulphur, crude	ton	20.00 - 22.00	.... - ....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 - .08½	.09 - .10
Sulphur (sublimed), flour	100 lb.	.... -	2.25 - 3.10
Sulphur, roll (brimstone)	100 lb.	.... -	2.00 - 2.75
Tin bichloride, 50 per cent	lb.	.18 - .19	.... - ....
Tin oxide	lb.	.... -	.40 - .42
Zinc carbonate, precipitate	lb.	.16 - .18	.19 - .20
Zinc chloride, gran	lb.	.11 - .11¼	.11½ - .12
Zinc cyanide	lb.	.45 - .49	.50 - .60
Zinc dust	lb.	.12 - .13	.13½ - .14
Zinc oxide, XX	lb.	.09 - .09¼	.09½ - .10
Zinc sulphate	100 lb.	2.90 - 3.00	3.25 - 3.75

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.10	— $1.15
Alpha-naphthol, refined	lb.	1.25	— 1.30
Alpha-naphthylamine	lb.	.35	— .40
Aniline oil, drums extra	lb.	.20	— .27
Aniline salts	lb.	.26	— .29
Anthracene, 80% in drums (100 lb.)	lb.	.75	— 1.00
Benzaldehyde U.S.P.	lb.	1.50	— ....
Benzidine, base	lb.	.85	— 1.00
Benzidine sulphate	lb.	.75	— .85
Benzoic acid, U.S.P.	lb.	.60	— .65
Benzoate of soda, U.S.P.	lb.	.55	— .60
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27	— .32
Benzene, 90%, in drums (100 gal.)	gal.	.25	— .28
Benzyl chloride, 95-97%, refined	lb.	.28	— .30
Benzyl chloride, tech	lb.	.20	— .25
Beta-naphthol benzoate	lb.	3.50	— 4.00
Beta-naphthol, sublimed	lb.	.70	— .75
Beta-naphthol, tech	lb.	.38	— .40
Beta-naphthylamine, sublimed	lb.	1.75	— 1.80
Cresol, U. S. P., in drums (100 lb.)	lb.	.16	— .18
Ortho-cresol, in drums (100 lb.)	lb.	.25	— .27
Cresylic acid, 97-99%, straw color, in drums	gal.	.70	— .80
Cresylic acid, 95-97%, dark, in drums	gal.	.65	— .70
Cresylic acid, 50%, first quality, drums	gal.	.45	— .50
Dichlorbenzene	lb.	.05	— .09
Diethylaniline	lb.	1.20	— 1.25
Dimethylaniline	lb.	.40	— .50
Dinitrobenzene	lb.	.26	— .28
Dinitroclorbenzene	lb.	.20	— .30
Dinitronaphthalene	lb.	.30	— .40
Dinitrophenol	lb.	.35	— .40
Dinitrotoluene	lb.	.27	— .30
Dip oil, 25%, car lots, in drums	gal.	.40	— .45
Diphenylamine	lb.	.60	— .65
H-acid	lb.	1.20	— 1.30
Meta-phenylenediamine	lb.	1.15	— 1.20
Monochlorbenzene	lb.	.12	— .14
Monoethylaniline	lb.	1.75	— 1.85
Naphthalene crushed, in bbls.	lb.	.07	— .08½
Naphthalene, flake	lb.	.07	— .08½
Naphthalene, balls	lb.	.08½	— .09½
Naphthionic acid, crude	lb.	.70	— .75
Nitrobenzene	lb.	.12	— .15
Nitro-naphthalene	lb.	.30	— .35
Nitro-toluene	lb.	.16	— .18
Ortho-amidophenol	lb.	3.10	— 3.20
Ortho-dichlor-benzene	lb.	.15	— .20
Ortho-nitro-phenol	lb.	.80	— .85
Ortho-nitro-toluene	lb.	.15	— .20
Ortho-toluidine	lb.	.20	— .25
Para-amidophenol, base	lb.	1.50	— 1.60
Para-amidophenol, HCl	lb.	1.75	— 1.80
Para-dichlorbenzene	lb.	.15	— .20
Paranitroaniline	lb.	.85	— 1.00
Para-nitrotoluene	lb.	.85	— .95
Para-phenylenediamine	lb.	1.75	— 2.00
Para-toluidine	lb.	1.25	— 1.40
Phthalic anhydride	lb.	.50	— .60
Phenol, U. S. P., drums	lb.	.11	— .13
Pyridine	gal.	2.00	— 3.50
Resorcinol, technical	lb.	1.75	— 1.85
Resorcinol, pure	lb.	2.25	— 2.30
Salicylic acid, tech., in bbls.	lb.	.19	— .22
Salicylic acid, U. S. P.	lb.	.20	— .25
Salol	lb.	.80	— .85
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25	— .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14	— .16
Sulphanilic acid, crude	lb.	.30	— .35
Tolidine	lb.	1.25	— 1.35
Toluidine, mixed	lb.	.40	— .45
Toluene, in tank cars	gal.	.25	— .28
Toluene, in drums	gal.	.28	— .31
Xylidines, drums, 100 gal.	lb.	.40	— .45
Xylene, pure, in drums	gal.	.40	— .45
Xylene, pure, in tank cars	gal.	.45	— ....
Xylene, commercial, in drums, 100 gal.	gal.	.33	— .35
Xylene, commercial, in tank cars	gal.	.30	— ....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.22	— $0.23
Beeswax, refined, light	lb.	.24	— .26
Beeswax, white pure	lb.	.42	— .45
Carnauba, Flora	lb.	.58	— .60
Carnauba, No. 2, North Country	lb.	.25	— .26
Carnauba, No. 3, North Country	lb.	.16	— .17
Japan	lb.	.17	— .17½
Montan, crude	lb.	.06½	— .06¾
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.03¼	— .03¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02¾	— ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼	— .03½
Paraffine waxes, refined, 125 m.p.	lb.	.04¼	— .04½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04¾	— .05
Paraffine waxes, refined, 133-135 m.p.	lb.	.05¼	— .05½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05¾	— .06
Stearic acid, single pressed	lb.	.09	— ....
Stearic acid, double pressed	lb.	.09½	— ....
Stearic acid, triple pressed	lb.	.10	— .10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.00	— ....
Rosin E-I	280 lb.	5.30	— 5.50
Rosin K-N	280 lb.	5.70	— 6.50
Rosin W. G.-W. W.	280 lb.	6.60	— ....
Wood rosin, bbl.	280 lb.	6.25	— ....
Spirits of turpentine	gal.	.58½	— ....
Wood turpentine, steam dist.	gal.	.56	— ....
Wood turpentine, dest. dist.	gal.	.54	— ....
Pine tar pitch, bbl.	200 lb.	......	— 6.75
Tar, kiln burned, bbl. (500 lb.)	bbl.	......	— 11.50
Retort tar, bbl.	500 lb.	......	— 11.50
Rosin oil, first run	gal.	.36	— ....
Rosin oil, second run	gal.	.38	— ....
Rosin oil, third run	gal.	.43	— ....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		$1.80
Pine oil, pure, dest. dist.	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.35
Turpentine, crude, sp. gr., 0.900-0.970	gal.		1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.35
Pinewood creosote, ref.	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.41
70-72 deg., steel bbls. (85 lb.)	gal.	.39
68-70 deg., steel bbls. (85 lb.)	gal.	.38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.30

Crude Rubber

Para—Upriver fine	lb.	$0.16	— .17
Upriver coarse	lb.	.09	— .09¾
Upriver caucho ball	lb.	.11½	— .12
Plantation—First latex crepe	lb.	.14½	— ....
Ribbed smoked sheets	lb.	.12	— .12¼
Brown crepe, thin, clean	lb.	.15	— ....
Amber crepe No. 1	lb.	.17	— ....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.08½	— $0.09
Castor oil, AA, in bbls.	lb.	.10	— .10¼
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.13½	— .13¾
Cocoanut oil, Ceylon grade, in bbls.	lb.	.10¼	— .10½
Cocoanut oil, Cochin grade, in bbls.	lb.	.11	— .11¼
Corn oil, crude, in bbls.	lb.	.07½	— .07¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.05½	— .05¾
Cottonseed oil, summer yellow	lb.	.07¾	— .08
Cottonseed oil, winter yellow	lb.	.08	— ....
Linseed oil, raw, car lots (domestic)	gal.	.76	— ....
Linseed oil, raw, tank cars (domestic)	gal.	.70	— ....
Linseed oil, in 5-bbl lots (domestic)	gal.	.80	— ....

Olive oil, Denatured	gal.	$1.35	— $1.45
Palm, Lagos	lb.	.06¾	— .07
Palm, Niger	lb.	.05½	— .05¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.06	— .06¼
Peanut oil, refined, in bbls	lb.	.10	— .10¼
Rapeseed oil, refined in bbls	gal.	.88	— .90
Rapeseed oil, blown, in bbls	gal.	.94	— .95
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.07¾	— ....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.05¾	— ....

FISH

Light pressed menhaden	gal.	$0.40	— $0.41
Yellow bleached menhaden	gal.	.42	— ....
White bleached menhaden	gal.	.44	— ....
Blown menhaden	gal.	.80	— ....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00	— 30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00	— 26.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00	— 12.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50	— 28.00
Barytes, crude, first grade, Missouri	net ton	7.00	— .....
Blanc fixe, dry	lb.	.04¼	— .04½
Blanc fixe, pulp	net ton	45.00	— 55.00
Casein	lb.	.08	— .10
Chalk, domestic, extra light	lb.	.05	— .05½
Chalk, domestic, light	lb.	.04½	— .05
Chalk, domestic, heavy	lb.	.04	— .05
Chalk, English, extra light	lb.	.05	— .07
Chalk, English, light	lb.	.05	— .06
Chalk, English, dense	lb.	.04½	— .05
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8.00	— 10.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12.00	— 15.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18.00	— 22.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15.00	— 30.00
China clay (kaolin), imported, lump	net ton	2.00	— 20.00
China clay (kaolin), imported, powdered	net ton	22.00	— 30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00	— 14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50	— 10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00	— 23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00	— 21.00
Feldspar ground, f.o.b. N. Y. State	net ton	17.00	— 21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00	— 30.00
Fullers earth, f.o.b. Mines	net ton	16.00	— 17.00
Fullers earth, granular, f.o.b. Pa	net ton	15.00	— 18.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00	— .....
Fullers earth, imported, powdered	net ton	24.00	— 27.00
Graphite, Ceylon lump, first quality	lb.	.07½	— .08
Graphite, Ceylon chip	lb.	.06	— .06½
Graphite, high grade amorphous crude	lb.	.02¾	— .03
Pumice stone, imported, lump	lb.	.04	— .50
Pumice stone, domestic lump	lb.	.05	— .05½
Pumice stone, ground	lb.	.06	— .07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	.....	— 10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	.....	— 14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	.....	— 17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00	— 7.50
Shellac, orange fine	lb.	.70	— .....
Shellac, orange superfine	lb.	.73	— .74
Shellac, A. C. garnet	lb.	.54	— .55
Shellac, T. N	lb.	.69	— .70
Soapstone	ton	12.00	— 15.00
Sodium chloride	long ton	12.50	— 13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00	— 20.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50	— 13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00	— 18.00
Talc, powdered, Southern, f.o.b. cars	ton	10.00	— 14.00
Talc, imported	ton	30.00	— 40.00
Talc, California talcum powder grade	ton	18.00	— 40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh		per ton	$37.50-40.00
Carborundum refractory brick, 9-in.	less than carlot	1,000	1250.00
	carload lots	1,000	1100.00
Chrome brick, f.o.b. Eastern shipping points		net ton	60 ...
Chrome cement, 40-45% Cr_2O_3		net ton	30- 32
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points		net ton	33- 35
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works		1,000	36- 40
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works		1,000	30- 35
Magnesite brick, 9-in. straight		net ton	70
Magnesite brick, 9-in. arches wedges and keys		net ton	77
Magnesite brick, soaps and splits		net ton	98
Silica brick, 9-in. sizes, f.o.b. Chicago district		1,000	42- 45
Silica brick, 9-in. sizes, f.o.b. Birmingham district		1,000	46- 50
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.		1,000	35- 38

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, carlots	lb.	.14 —	....
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.15 —	....
Ferromanganese, 76-80% Mn, domestic	gross ton	70.00 —	75.00
Ferromanganese, 76-80% Mn, English	gross ton	70.00 —	75.00
Spiegeleisen, 18-22% Mn	gross ton	27.00 —	28.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.50 —	.....
Ferrosilicon, 10-15%	gross ton	40.00 —	42.00
Ferrosilicon, 50%	gross ton	68.00 —	70.00
Ferrosilicon, 75%	gross ton	40.00 —	145.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.45 —	.50
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V	lb.	5.00 —	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	gross ton	$8.00 —	$10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.40 —	.45
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	unit	.40 —	.45
Coke, foundry, f.o.b. ovens	net ton	4.00 —	4.50
Coke, furnace, f.o.b. ovens	net ton	3.00 —	3.25
Coke, petroleum, refinery, Atlantic seaboard	net ton	15.00 —	16.00
Fluorspar, lump, f.o.b. mines, New Mexico	net ton	12.50 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	18.00 —	20.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01¼ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.25 —	.....
Manganese ore, chemical (MnO_2)	gross ton	55.00 —	60.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55 —	.60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.14 —	.14
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.14 —	.14
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	.12 —	.13
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.75 —	3.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.00 —	3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50 —	2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free	lb.	.03 —	.....

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	12.85-13.00
Aluminum, 98 to 99 per cent	28.0@28.5
Antimony, wholesale lots, Chinese and Japanese	5¼
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, spot and block	35.00
Monel metal, ingots	38.00
Monel metal, sheet bars	40.00
Tin, 5-ton lots, Straits	28.75-29.00
Lead, New York, spot	4.40
Lead, E. St. Louis, spot	4.15
Zinc, spot, New York	4.75
Zinc, spot, E. St. Louis	4.35-4.40

OTHER METALS

Silver (commercial)	oz.	$0.58½
Cadmium	lb.	1.00-1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	4.00
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	75.00
Iridium	oz.	160.00@180.00
Palladium	oz.	70.00
Mercury	75 lb.	46.00-47.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	21.25-21.50
Copper bottoms	28.75-29.00
Copper rods	20.00
High brass wire	17.25
High brass rods	14.25
Low brass wire	18.75
Low brass rods	18.75
Brazed brass tubing	27.50
Brazed bronze tubing	32.25
Seamless copper tubing	22.00
Seamless high brass tubing	20.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible	9.25@ 9.50	9.25	9.50
Copper, heavy and wire	8.25@ 8.50	8.50	8.50
Copper, light and bottoms	7.25@ 7.75	7.50	7.25
Lead, heavy	3.25@ 3.50	3.25	3.25
Lead, tea	2.25@ 2.35	2.25	2.25
Brass, heavy	4.25@ 4.50	4.50	5.00
Brass, light	3.25@ 3.50	3.25	3.50
No. 1 yellow brass turnings	4.25@ 4.50	4.25	4.50
Zinc	2.00@ 2.50	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.60	$3.23	$3.23
Soft steel bars	2.50	3.00	3.13
Soft steel bar shapes	2.50	3.13	3.13
Soft steel bands	2.85	3.83	3.78
Plates, ¼ to 1 in. thick	2.50	3.30	3.23

*Add 15c per 100 lb. for trucking to Jersey City and 10c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

HELENA—S. A. and B. L. Lane, Little Rock, Ark., are negotiating with the Chamber of Commerce, Helena, for a suitable site for the erection of a new local oil refinery. The initial unit is estimated to cost about $35,000.

Connecticut

NORWALK—Charles H. Harris, Inc., has been incorporated under Connecticut laws with capital of $500,000, to manufacture glassware products. The company has recently awarded a contract for the erection of a new 1-story plant on Main Street, 100 x 200 ft., estimated to cost about $75,000. It will be affiliated, it is understood, with the company of the same name, with offices at 135 W. 24th St., New York. Charles H. Harris, Penn Ave., Norwalk, is president.

Delaware

WILMINGTON—The Darco Corp., a subsidiary of the Atlas Powder Co., du Pont Bldg., has arranged for a bond issue of $1,500,000, the proceeds to be used for the erection of a new plant in Louisiana for the manufacture of refined carbon products, known as "Darco," used in connection with the production of sugar, gelatine, etc. The plant will have an initial daily capacity of close to 5,000 tons.

Florida

ST. PETERSBURG—The Shinem Mfg. Co., manufacturer of polishes, has plans under way for the erection of a new 2-story plant, 40 x 100 ft., for the manufacture of its regular specialties. George W. Wrennick is general manager.

Georgia

ATLANTA—The Cotton State Rubber Mfg. Co., recently organized, is planning for the establishment of a new plant for the manufacture of rubber goods, including belting, packing and other mechanical specialties. George J. Reiter is president, and W. S. McKemia secretary.

Illinois

OREGON—The Paragon Foundries Co., manufacturer of plates and other iron castings, has plans under way for the erection of a new 1-story addition, 100 x 200 ft., to cost about $50,000. N. E. Buser, Mount Morris, Ill., is architect; James Reed is president.

Kentucky

LOUISVILLE—The Southern Iron & Steel Co., recently organized, will operate a local plant for the manufacture of bar iron, squares, rounds, etc. It is planned to develop a daily output of about 75 tons. E. M. Drummond is president, and James A. Drummond secretary and treasurer.

Maryland

BALTIMORE—The American Sugar Refining Co. is continuing to file plans for the erection of buildings at its new local refinery at Woodall and Clement Sts., and the latest permit issued provides for the construction of a 7-story pan house, 80 x 154 ft.

Massachusetts

EAST LONGMEADOW—The New England Steel Castings Co., Shaker Rd., is reported to be planning for the rebuilding of its plant, destroyed by fire, June 15, with loss estimated at close to $100,000, including equipment.

FALL RIVER—The New England Refining Co., Peat St., has filed plans for the erection of a new oil separator building to cost about $50,000, and new gas holder to cost about $36,000. Construction will begin at once.

Minnesota

HIBBING—The Mahoning Iron & Steel Co. has completed plans for the immediate erection of a new laboratory building at its local properties, known as the Mahoning Mine.

New Jersey

PERTH AMBOY—One of the buildings at the plant of the American Agricultural Chemical Co., Roosevelt district, was recently destroyed by fire, with loss estimated at about $15,000.

TRENTON—The Miller-Steiner Rubber Co., recently incorporated with a capital of $100,000, has taken over the plant of the Olden Rubber Co., 678-94 North Olden Ave., and will establish a plant for the manufacture of mechanical rubber goods. Alterations will be made and machinery installed at once. It is proposed to commence operations early in July. John M. Miller is president and general manager.

NEWARK—The Wilson Imperial Co., Hermon St., manufacturer of polishes, paint and varnish removers, etc., has acquired property adjoining its plant, heretofore held by the Storms Co., manufacturer of dumbwaiters, etc. The property is 90 x 165 ft., improved with a 2-story building, totaling about 15,000 sq.ft. of manufacturing space. It will be used, in part, by the new owner for expansion.

NEWARK—The Irvington Smelting & Refining Works, Nye Ave., has commenced the installation of a new precipitator for the prevention of acid fumes at its plant.

New York

BEACON—The Beacon Tire & Rubber Co. has awarded a contract to Amos Jones, 45 North St., for the erection of a 3-story addition to its plant, 50 x 80 ft., estimated to cost about $25,000.

ITHACA—The Superintendent of Buildings and Grounds, Cornell University, has taken bids for the erection of the proposed new 4-story chemical laboratory at the institution, 192 x 268 ft., estimated to cost close to $2,000,000. Gibb & Waltz, 110 North Tioga St., are architects.

North Carolina

ASHEVILLE—James E. Rector, head of Rector, Blackstock & Taylor, 8 Technical Bldg., is planning for the installation of new equipment at his local brick manufacturing plant, comprising the former works of the Asheville Shale Brick Co., recently acquired under lease. New drying machinery and burning apparatus will be provided. It is proposed to develop an output of about 25,000 bricks per day.

Ohio

CAREY—The Hume China Co. will take bids early in July for the erection of its proposed new 1-story pottery, 150 x 500 ft., to be equipped for the manufacture of general ware. W. W. Matchett, 408 Alliance Bank Bldg., Alliance, O., is architect. George H. Hume is president.

NILES—F. A. Sebring, Sebring, O., operating a local pottery for the manufacture of general ware, has acquired the interests of W. H. Tritt in the Tritt China Co., Niles.

Oklahoma

ONETA—The Oneta Refining Co. is perfecting plans for the erection of its proposed new oil refinery at Pine Bluff, Ark., to have an initial daily capacity of about 1,000 bbl. The new plant with machinery is estimated to cost close to $300,000. H. C. Mier, vice-president, is in charge.

PRESTON—The Taylor Oil & Gasoline Co., 265 Post Office Bldg., Okmulgee, Okla., recently organized with a capital of $500,000, has perfected plans for the erection of a new two-unit gasoline plant at Preston. It is proposed to develop a daily output of about 2,500 gal. The plant is estimated to cost in excess of $150,000. Contracts for certain equipment have been awarded. William A. Taylor is president. A. B. Patterson, Tulsa, Okla., is engineer.

TULSA—Cosden & Co., operating a local oil refinery, will make improvements and extensions at their power house to cost about $100,000, including boilers and other equipment.

Pennsylvania

PARKERS LANDING—The Wightman Bottle & Glass Co. has resumed operations at two more shops at its local plant for increased production. A number of repairs and improvements have been made in the buildings during a shut-down for over a month past. The plant will operate on two 8-hour shifts.

BEDFORD—Property of the Philadelphia Vitrified Brick Co., in Bedford Co., near Bedford, will be offered at public sale on July 11, by J. M. Fink, trustee. The plant consists of a complete works for the manufacture of vitrified brick, with adjoining property totaling over thirty-five acres.

PHILADELPHIA—The Mutual Rendering Co. has taken title to the plant of the Hafleigh Rendering Co., Ontario and Brabant Sts., devoted to the manufacture of tallow and affiliated products, and will operate the plant at this location. A consideration of about $90,000 was given for the property.

South Carolina

GAFFNEY—The McCraw Brick Co. is planning for the installation of new machinery at its plant, to include a department for the manufacture of pressed bricks. A new steam shovel is also being considered, for installation at the clay properties. C. D. Meadows is secretary and treasurer.

Virginia

RICHMOND—The R. A. Cauthorne Paper Co. Inc., Tenth and Carey Sts., has tentative plans under way for the erection of a new local paper manufacturing plant, on site at Hull and Brander Sts., estimated to cost about $75,000. Carneal & Johnson, Chamber of Commerce Bldg., are architects.

BOYDTON—Baptist & Goode are considering the erection of a new plant on local site for the manufacture of bricks and other burned clay products.

Tennessee

MT. PLEASANT—The Phosphates Products Co., recently incorporated with a capital of $25,000, will operate a local fertilizer manufacturing plant. E. E. Fisher and N. B. Stewart, Mt. Pleasant, head the company.

KINGSPORT—Under a decree issued by the Chancery Court, the local plant of the Union Dye & Chemical Co. will be offered at public sale on Aug. 10. The plant is now in the possession of the Equitable Trust Co., New York, trustee. It is estimated in value in excess of $2,500,000.

Texas

SHERMAN—The Buffalo Producing & Refining Co. is arranging for an increase in the capacity of its plant from 300 to 1,000 bbl. of oil daily. The company recently acquired the Texas Interstate Producing & Refining Co. in connection with its expansion plans.

Washington

LA GRANDE—The American Nitrogen Products Co., operating a local plant, has made application to the Port Commission, Seattle, Wash., for a suitable site for the erection of a new plant for the manufacture of nitrogen products. It is proposed to acquire a tract of about four acres of land for the works, which are estimated to cost approximately $500,000 with machinery. The company is now operating a branch plant at Lake Buntzen, near Vancouver, B. C.

West Virginia

FAIRMONT—The Monongah Glass Co. has awarded contracts for the installation of new equipment at its plant, to provide for increased production. Gas producers, conveying apparatus and kindred machinery will be installed. R. T. Cunningham is secretary and treasurer.

HORTON—The Parsons Pulp & Lumber Co., Finance Bldg., Philadelphia, Pa., is planning for the erection of a new mill in the vicinity of Horton for the manufacture of pulp products. The company will develop extensive properties both at Horton and Seneca, W. Va.

New Companies

THE PREMIUM OIL CORP., 1404 Harris Trust Bldg., Chicago, Ill., has been incorporated with a capital of $50,000 to manufacture refined oil products. The incorporators are H. M. Cassidy, Stanley Rich and R. O. Farrell.

THE ADAMANTEX BRICK CO. OF NEW ENGLAND, INC., Boston, Mass., has been incorporated with a capital of $400,000, to manufacture bricks and burned clay products. John R. Honors is president; and Frank S. Perkins, 393 Essex St., Salem, Mass., treasurer.

THE LIPTON SALT CO., New York City, has been incorporated with a capital of $10,000 to manufacture salt and salt byproducts. The incorporators are C. Lipton, J. Schlesinger and H. Dressner. The company is represented by L. Schfran, 51 Chambers St.

THE LA-HUNT OIL CO., Los Angeles, Cal., has been incorporated with a capital of $500,000 to manufacture petroleum products. The incorporators are John G. Clark, S. J. Bowman and George Dennison. The company is represented by Cranahan & Clark, 501 Chapman Bldg.

THE BLACK DIAMOND IRON SYNDICATE, Salem, Ore., has been incorporated with a capital of $100,000 to operate an ore reduction and smelting plant. The incorporators are E. S. Deardorff and O. P. Coshow, Salem.

THE PETROLEUM PRODUCING & REFINING CO., 10 South La Salle St., Chicago, Ill., has been incorporated with a capital of 200 shares of stock, no par value, to manufacture refined oil products. The incorporators are John B. Weeden, H. J. Chatford and S. X. Willard.

THE LEATHER CHEMICAL PRODUCTS CORP., Newark, N. J., has been incorporated with a capital of $100,000 to manufacture chemical products for leather service. The incorporators are Benjamin Shanefield, H. Kearns and Meyer Rashkes, 9 Clinton St.

THE FARNUM GLASS CO., Cambridge, Mass., has been incorporated with a capital of $10,000 to manufacture glass specialties. G. F. Farnum is president; and Henry M. Rockwell, 496 Commonwealth Ave., is treasurer.

THE RIBBON STEEL PRODUCTS CORP., Brooklyn, N. Y., has been incorporated with a capital of $50,000, to manufacture steel specialties. The incorporators are C. V. Reynolds, C. W. Lockwood, and R. Rae. The company is represented by J. P. Bromell, 17 E. 42d St.

THE LONG BEACH-MIDWAY PETROLEUM CO., Long Beach, Cal., has been incorporated with a capital of $400,000 to manufacture petroleum products. The incorporators are J. F. Steele, Carl Pohl, and John H. Burke, First National Bank Bldg., Long Beach.

GEORGE F. SNYDER, INC., Alpena, Mich., has been incorporated with a capital of $50,000 to manufacture aluminum, brass, bronze and other metal castings. Samuel Taig and George F. Snyder, Alpena, are the incorporators.

THE THREE POINT PRODUCTS CORP., Albany, N. Y., has been incorporated with a capital of $200,000 to manufacture chemicals, soaps and kindred products. The incorporators are E. F. Dolan, L. K. Luff and F. P. Gutelius. C. J. Tobin, Albany, represents the company.

THE LA PREME IVORY NOVELTY CO., East Passaic Ave. and Center St., Bloomfield, N. J., has filed notice of organization to manufacture celluloid and other composition products. Richard Webster heads the company.

THE GLOVER-KRASNOW CO., INC., Springfield, Mass., has been incorporated with a capital of $10,000 to manufacture leather products. George Krasnow is president and George E. Glover, 211 Main St., treasurer.

THE METAL-CRAFT MFG. CO., Room 1018, 64 West Randolph St., Chicago, Ill., has been organized to manufacture metal products. The company is headed by Henry J. Ward and William B. Bosworth.

THE PARKER-KISKADDEN CO., Detroit, Mich., has been incorporated with a capital of $20,000 to manufacture greases, lubricants, etc. The incorporators are Charles A. Parker and Cameron H. Kiskadden, 16 Davenport St.

THE PETERSEN MFG. CO., INC., Scotch Plains, N. J., has been incorporated with a nominal capital of $5,000, to manufacture asbestos products. The incorporators are George A. Oddie and George F. W. Petersen, Mountain Ave. and Stout St., Scotch Plains.

THE INTERNATIONAL EXTRACT CO., Lake Charles, La., has been incorporated with a capital of $20,000, to manufacture prepared extracts, chemicals, etc. Adolph Lagrange is president, and John J. Dubourg, secretary and treasurer, Lake Charles.

THE OCEAN OIL CO., Long Beach, Cal., has been incorporated with a capital of $250,000 to manufacture petroleum products. The incorporators are V. S. Craig, C. M. Chandler and G. M. Spicer, 431 First National Bank Bldg., Long Beach.

THE JUS-TEL CHEMICAL CO., Brooklyn, N. Y., has been incorporated with a capital of $50,000 to manufacture chemicals and chemical byproducts. The incorporators are A. and B. Juster, and E. Buchman. The company is represented by M. Eichner, 1545 B'way.

THE DETROIT ALLOY STEEL CO., Detroit, Mich., has been incorporated with a capital of $50,000 to manufacture steel products. The incorporators are Frank L. Griffin, Robert H. Hall, and John Grant, 1938 Taylor Ave.

THE MACCO MFG. CO., Holyoke, Mass., has been incorporated with a capital of 5,000 shares of stock, no par value, to manufacture paper and paper products. William P. Corkindale is president; and Frank A. Gates, Holyoke, treasurer.

THE ILLINOIS GRAPHITE CO., 155 North Clark St., Chicago, Ill., has been incorporated with a capital of $10,000 to manufacture graphite products. The incorporators are H. G. Sampson, W. J. Hough and E. M. Park.

B. TOUGIAS, INC., New York City, has been incorporated with a capital of $25,000 to manufacture oil products. The incorporators are B. Tougias, L. Fish and S. Schiff. The company is represented by Kahn & Zorn, 66 B'way.

Capital Increases, Etc.

THE SENECA COPPER CORP., 11 B'way., New York City, has filed notice of increase in active capital from $1,250,000 to $1,700,000.

THE UNITED STATES REDUCTION CO., East Chicago, Ind., has filed notice of increase in capital from $150,000 to $350,000.

THE GENERAL CHINAWARE CORP., organized under Delaware laws with capital of $850,000, has filed notice of organization to operate in New York for the manufacture of chinaware. R. D. Buchholtz, 15 Broad St., is representative.

THE CORONET PHOSPHATE CO., 99 John St., New York City, has filed notice of increase in capital from $2,500,000 to $3,000,000.

THE BROOKLYN PUTTY WORKS, 50 Bergen St., Brooklyn, N. Y., have filed notice of increase in capital to an active amount of $10,000.

THE GENERAL PETROLEUM CO., 310 Sansome St., San Francisco, Cal., has arranged for a note issue of $10,000,000, the proceeds to be used for expansion, general operations, financing, etc.

THE ST. LOUIS COKE & CHEMICAL CO., St. Louis, Mo., has arranged for a bond issue of $10,000,000, the proceeds to be used for future expansion and current operations. Of the total amount, $6,545,000 will be issued and sold immediately.

THE FISCHER & HAYES ROPE & STEEL CO., 741 West Van Buren St., Chicago, Ill., manufacturer of wire rope, etc., has filed notice of increase in capital from $30,000 to $150,000.

New Publications

BOOKS

AMERICAN BUSINESS METHODS. By *Floyd W. Parsons*, E.M. Pp. 373. New York: G. P. Putnam's Sons, 1921. Price, $2.50.

"The purpose of this book is to supply the reader with practical knowledge of ways and means to increase production in any and all lines of business. In a material sense, production is the true measure of success of a corporation or an individual. Generally speaking, the fundamental principles of business are quite similar whether a man manufactures locomotives or sells lead pencils. The real secret of 'getting ahead' in any line of work appears to be ability to adapt the best practices of others to the business in hand.

"The data contained in this volume have been gathered from hundreds of leaders in dozens of industries. Much of the information has resulted from careful research and personal interviews, and has formed the foundation of articles published in the 'Everybody's Business' department of the *Saturday Evening Post*. In fact, the volume has been created largely as a result of the requests of many *Post* readers that the facts presented be elaborated and collected in book form.

"It is probably true that the book as a whole represents more research and more hours of labor than has ever before been devoted to any work of a kindred nature. There are many splendid books covering definite and distinct phases of business procedure, but investigation fails to disclose any volume that attempts the ambitious plan of treating all of the important problems that underlie modern commercial and industrial practice."

This mass of data has been arranged and classified so as to present continuity of thought under the headings or chapters: Industrial Relations; Health and Industry; Light and Ventilation; Labor-Saving Machinery; Advertising and Selling; Business Methods and Ideas; Foreign Trade Problems and Practices; Application of Science to Industry.

THE CHEMICAL ALLIANCE, INC., IN THE WORLD WAR. Pp. 82. Philadelphia: The Chemical Alliance, Inc., 1921.

This historical review of the Chemical Alliance, Inc., has been compiled pursuant to a request from the Historical Bureau of the General Staff, War Department, to all war service organizations to furnish reports of their activities. It has been prepared to form a permanent record of the object, organization and activities of the Chemical Alliance and its service to the Government during the war period and in the solution of after-war problems.

The first part of the review comprises a report by the president, Horace Bowker, which was presented at the second annual meeting, held at New York City, Jan. 22 and 23, 1919. Incorporated in Mr. Bowker's report are brief records of the activities of the various committees which had been functioning during the war and post-war periods.

The latter part of the book records the cessation of the activities of the Alliance, together with the appreciation of its services by Government officials. The closing record is the decision to continue the Alliance indefinitely as an inactive organization.

FACTORY CHEMISTRY. By *William H. Hawkes*, M.Sc., department of chemistry, Ford Institute of Technology, Detroit, Mich. Pp. 59. New York: Longmans, Green & Co., 1921. Price $1.

This is a very elementary treatment especially designed for factory men interested in the study of chemistry as it bears on the various operations in factory processes. A short outline of qualitative analysis is included, so that the book is preparatory to courses in quantitative metallurgical analysis and metallography.

THE BUSINESS LIBRARY—WHAT IT IS AND WHAT IT DOES. By *Louise B. Krause*. Pp. 124, illustrated. San Francisco: *Journal of Electricity and Western Industry*.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY'S summer meeting will be held at Canton, Alliance, Sebring and East Liverpool, Ohio, July 25 to 27. Headquarters will be at the Hotel Courtland, Canton, Ohio.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magazine from time to time.

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TITANIUM TALKS

No. 38

The Gear Tooth (referred to in Talk No. 37) was made from steel of the following composition: C. .18; Mn. .57; P. .018; S. .048; Si. .13; first rolled then drop forged, carbonized and given two quenches in oil.

The polished section as received showed numerous streaks of alumina inclusions, with a few fine sulphides. One of these streaks was shown in microphotograph (Talk No. 37)—the other showing the actual CRACK FOLLOWING THE LINE OF ALUMINA INCLUSIONS—is reproduced herewith.

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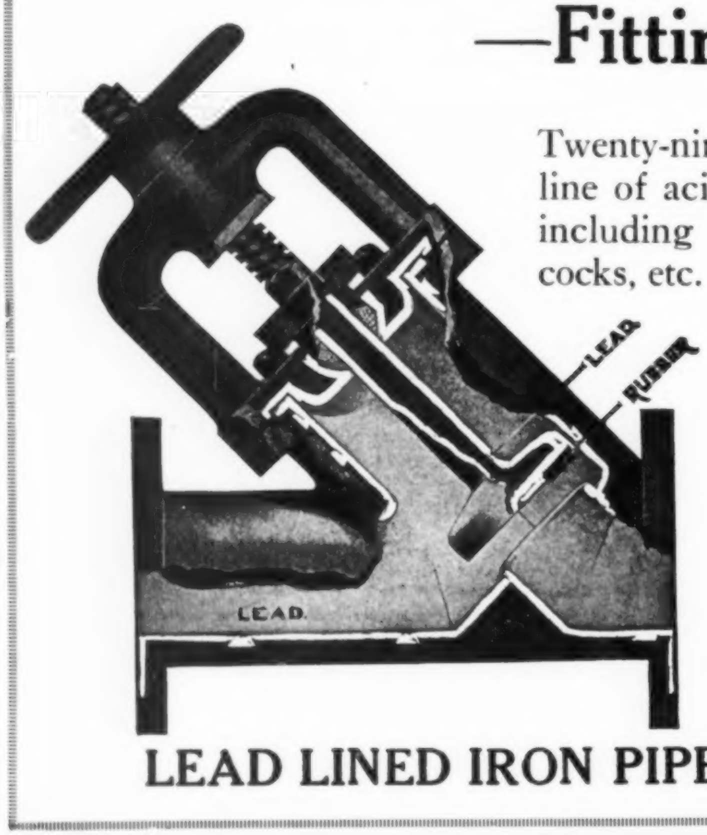
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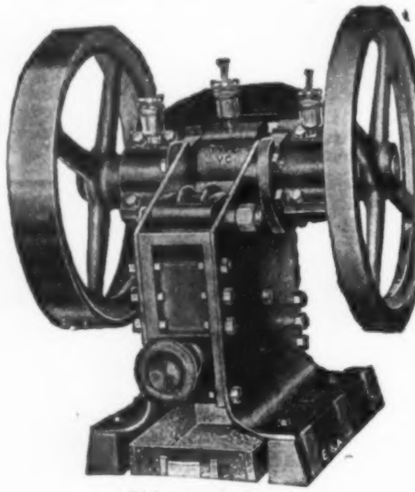

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No. 3442—Braun Combination Furnaces. The muffle is placed above the crucible compartment. Temperature obtainable with Braun gas burner, No. 1538, 1280° C. and with Cary hydrocarbon burner, No. 1446, 1150° C.

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No. 192—Evaporator for reducing asphaltic petroleums to asphalt.

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No. 193½—Adhesivemeter—for testing the adhesiveness or sticky qualities of oil.

No. 2719—Oil Still for fractionations and general distillations.

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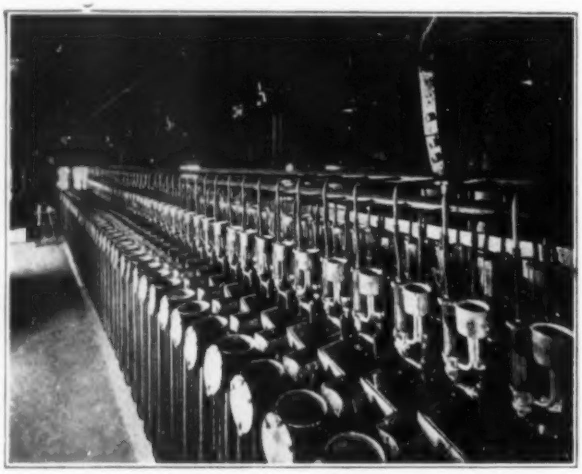

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1—**NITRATOR**, Buffalo, 800 gal., 5 ft. dia., 6 ft. deep, cooling jacket.
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Rotary Vacuum Dryers, 4 x 10 ft., 5 x 30 ft. and 5 x 33 ft.
Vacuum Shelf Dryers, 20 shelf and 17 shelf.
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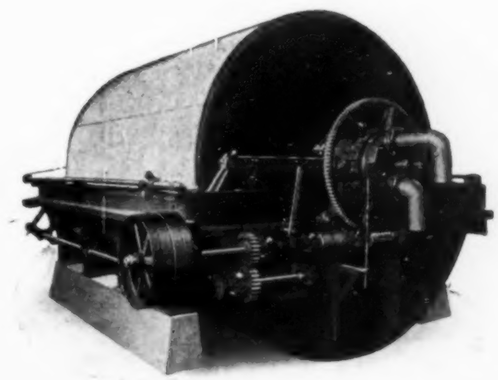

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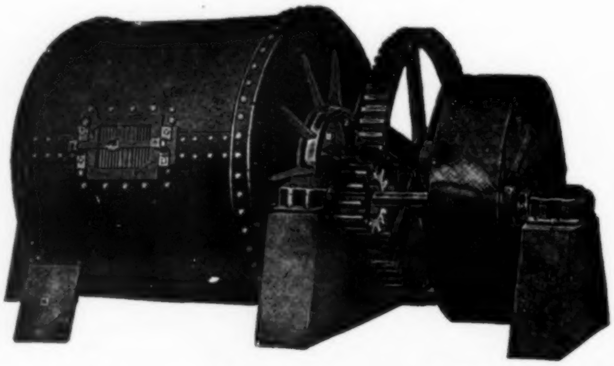

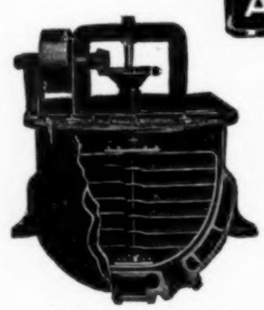

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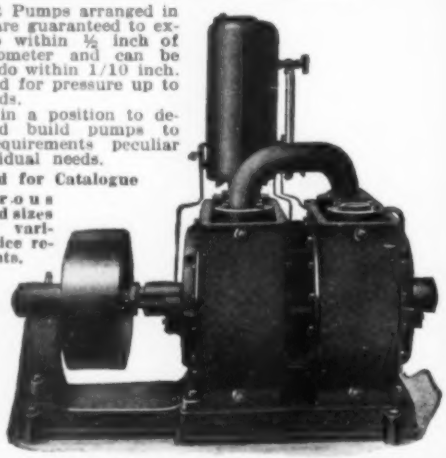

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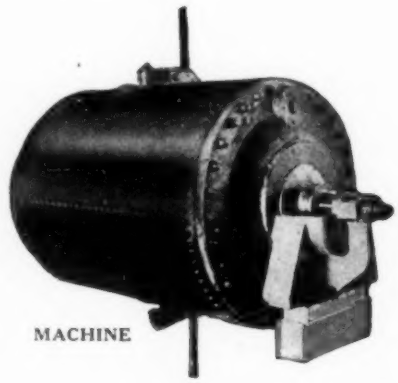

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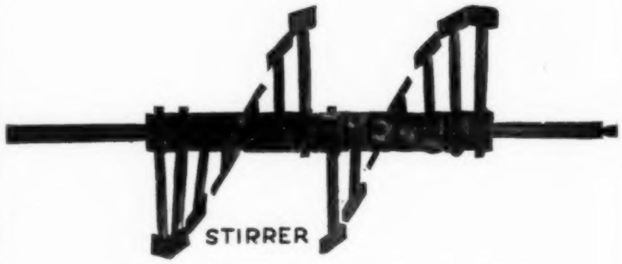

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Semet Solvay Co.

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Semet Solvay Co.

Benzol Plants
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Connersville Blower Co.
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Nash Engineering Co., The
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